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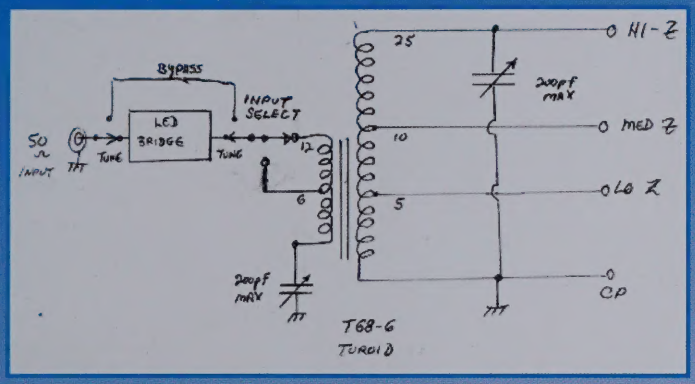
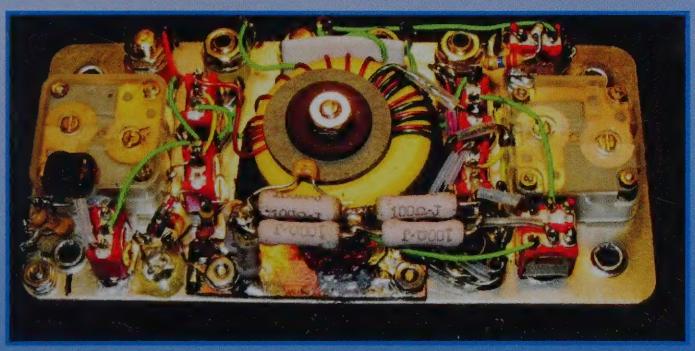
QRP Quarterly

Volume 60 Number 2
April 2019

Journal of the QRP Amateur Radio Club International





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- The Idea Exchange—Antennas, Cool Paddles, DC Power and Test Gear
- Check Your Antenna With K4OCE's Remote Field Strength Meter
- VE3IPS Wants You to Answer 10 Questions About QRP Operations!
- Rememberances of Rev. George Dobbs, G3RJV (SK)

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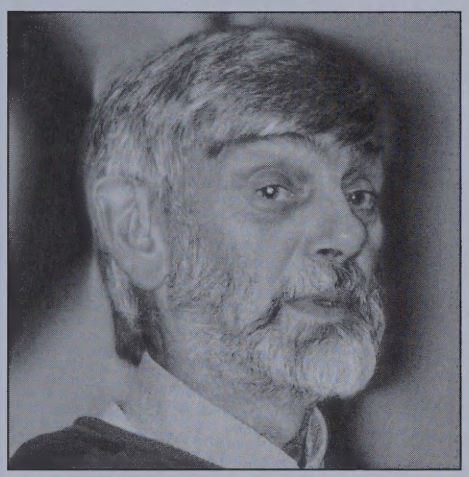

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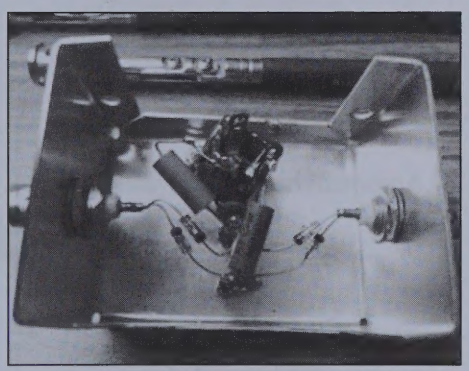

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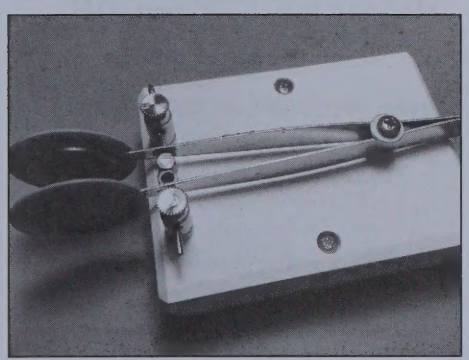

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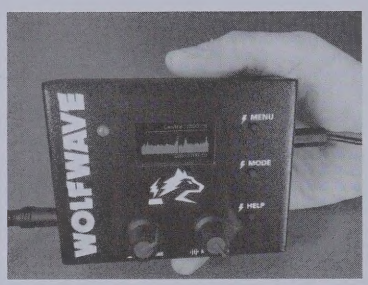

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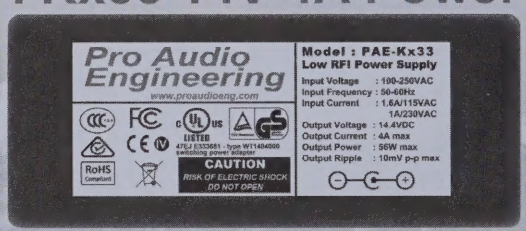

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Editorial

Mike Malone—KD5KFX editor@qrparci.org

Spring has finally arrived in Texas along with some good old 'remodel the antenna farm' wind. I am always up early after a late night storm, checking to see if my antlers survived the latest blow. So far so good, knock on wood, the only repairs have been replacing paracord and replacing a few zip ties. Speaking of things blowing in, we have some fun things coming up that mark some of your spring calendars.

The 4 States Ozarkcon is coming up in the first weekend in April, if you have not attended one yet—you really should. I will be there with my XYL and the 4SQrp gang always put on a great event. The very next month is the king of QRP events in the States and perhaps internationally—FDIM! Four days in May! Every QRPer should attend at least once. There is nothing in the world like it, a chance to be around a group with a tightly shared interest, meeting your personal heroes, making new friends, putting faces to call signs you have worked, and... oh yeah—there is a little hamfest that goes on there too. Dayton! Walking the outside flea market, eating a good old fashioned bratwurst, and scoring up all kinds of goodies for your homebrew endeavors.

Spring is also antenna maintenance and erection season for many of us, please be careful in your efforts. It seems like at least one bad accident occurs every spring and makes the rounds of eham and forum groups. While I am guilty of doing a lot of solo antenna work, the last few years have found me enjoying camaraderie with a couple of other hams and all of us pitching in on each others antenna work. There is not much better than some grilling and antenna work, combined with good ham fellowship.

Until next time, may your antennas stay up and your noise floor down.

Mike Malone KD5KXF
kd5kxf@gmail.com

From the President

Preston Douglas—WJ2V president@qrparci.org

It's late March, and the weather is finally getting much nicer. The kids are playing in the city parks, and for me, walking the dog outside is a treat instead of a trial. I expect many of us will get out with our portable rigs to enjoy a few hours' operating outside of the shack. There are chess tables and benches out in John Jay Park, across the street from my building, and I think it's time I got the FT-817 out of the case and tried it out. I will be looking for a loop to sit on the table with me, so it will be unobtrusive as possible. This hiatus in operating since I moved into the big City has got to come to an end!

FDIM

The plans are laid. We already have just about two hundred pre-sign ups for the seminar and nearly that many for the banquet. We have commitments from some of our favorite QRP vendors for donations of top of the line keys, loops, antenna set-ups, rigs and more for door prizes. We will raffle off a fully let out Elecraft KX3, and we'll have a KX2 to give away too. I always buy a raffle ticket, though if I won, I wouldn't keep it. So, figure this. Your chances of winning are slightly better with me in it!

The seminar lineup is terrific, It was hard to squeeze all these talks into one day. As it is, it's going to be a very full day. Take a look:

9:00-9:45	Jerry Wolczanski, "A DC Transceiver"
9:50-10:35	Rick McGaver, "Quartzfest"
10:35-11:00	Break
11:00-12:00	Hans Summers, "Challenges of SSB"
12:00-1:30	Lunch
1:30-2:30	Dave Cripe, "Reinartz and the Radio Boy"
2:30-2:45	Break
2:45-4:30	Joe Everhart and George Heron (3 topics): "Portable QRP Antennas", "Homebrewing a Shack", and "Arduino-based Audio Analyzer"
4:30-5:15	Jack Purdum, "Creating Your Own CW Tutor"

The times may still get a slight adjustment, but that's a lot of great speakers. It's not too late to get your seat for this event.

It is hard to believe that FDIM has been going on for so many years, though it is true that we've lost a lot of our QRP gang over that time. We note with sadness the passing of several, but have to mention our old friends Rev. George Dobbs and Cam Harford whose keys went silent this year. They were both stalwarts at FDIM, and major supporters of the QRP movement. They are missed already.

Part of the job of president of QRP ARCI is dealing with lost or missing *QRP Quarterly* issues for members. Consider the size of our active membership, we do a pretty good job of getting those issues out there; but occasionally one goes astray. Assuming the member is up to date in dues (not always the case, by the way) we try to resolve the issues about issues. Between Charlotte Nelson, and Bill Kelsey, the members get their issues.

Speaking of the great support people we have (and just check out the list of volunteers who fill the many jobs listed in the back of your *QQ*), we need a volunteer. Bob Lusby, who has served our club well and long, is asking to resign his post as Awards Manager. Is there a volunteer who is, perhaps, an awards chaser who can cover that desk? Let me know—it is an important part of our operation.

Finally, it's antenna time again. Please do it safely...

—Preston Douglas, WJ2V
President, QRP ARCI

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Here's a list — see "Links" on the club website for more info!

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20m	14060 kHz	14285 kHz
17m	18096 kHz	18130 kHz
15m	21060 kHz	*21285 kHz* 21385 kHz
12m	24906 kHz	24950 kHz
10m	28060 kHz	*28365 kHz* 28385 kHz
6m	50096 kHz	50185 kHz
2m	144060 kHz	144285 kHz

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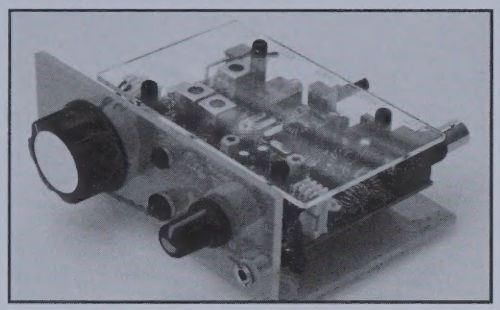

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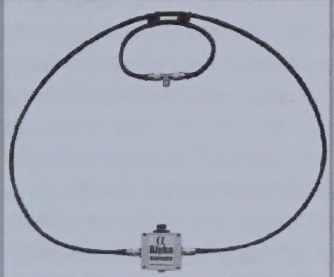

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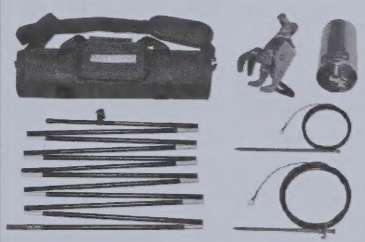

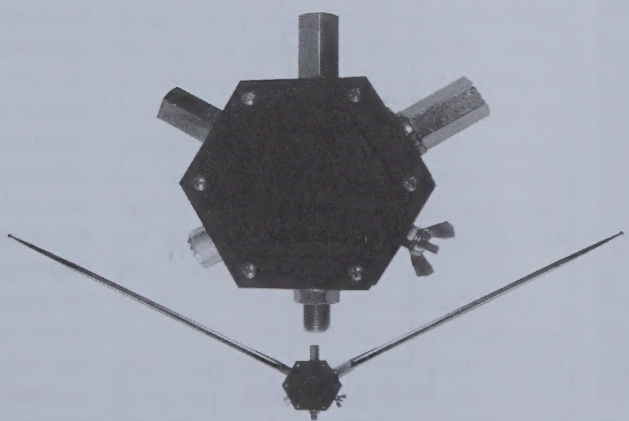

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Idea Exchange

Technical Tidbits for the QRPer

Mike Czuhajewsi—WA8MCQ wa8mcq@verizon.net

In this edition of the Idea Exchange:

G3RJV, Silent Key
GO-TO Antenna on 60 and 80 Meters—N2CX
Unconventional Keys and Paddles—K4LXY
Boost Converter for 14V Devices—N9DK
No-Moving-Parts Straight Key—K4LXY
HP355C Attenuator Repair—WA8MCQ

G3RJV, Silent Key

I am deeply saddened to report the passing of the Rev. George Dobbs, G3RJV, in March 2019. Although perhaps not as well known on this side of the pond, he was very well known in Europe. He was the founder of the GQRP Club in 1974 and editor of its journal, SPRAT, and spoke at many gatherings on both sides of the pond. He was having some medical issues and succumbed to an illness that would not respond to medications. He will be greatly missed.

I have fond memories of running into him and his wife in the hallway of the "QRP hotel" at Dayton a few decades ago. I had two Altoids tins in my hands. I showed them the QRP rig I had built into one and offered them some mints from the other.

GO-TO Antenna on 60 and 80 Meters

From Joe Everhart, N2CX, #108 in the endless string of Technical Quickies he promised me a few decades ago—

I've been using my GO-TO antenna for some time now with good success on 20, 30 and 40 meters in my portable outings. There have been several variations on this theme and the latest uses a "7.2m" pole found on eBay. It is actually only 17 feet long so I guess "m," which I interpret as meters, somehow got lost in the translation.

In my last Quickie I described adding a loading coil to the 40 meter sloper, one of my other portable antennas, to add 60 and 80 meter capability with some NVIS (near vertical incidence skywave) radiation, an advantage for close-in contacts [Ref 1]. But it would be handy to use my GO-TO on those bands as well, even if high-angle radiation is not possible with a straight vertical. I realize that a 16 foot vertical will certainly not be the most efficient antenna, but it just might be good enough for casual use when I want a quick hit on the lower bands.

Electrically the same idea is applied as with my loaded sloper. I simply add some loading coils at the base of the wire to resonate it on the other bands. The sloper uses a length of PVC pipe on my mobile mount for the loading coil scheme. The antenna wire is connected to the top of the coil and a clip lead goes from the bottom of the coil to the feedline center conductor. However, a different scheme is needed for the pole-mounted wire. I decided to use a length of 1" PVC pipe slid over the fishing pole as the coil form. The antenna wire is again clipped to the top of the coil and a clip lead makes the coax feedline connection.

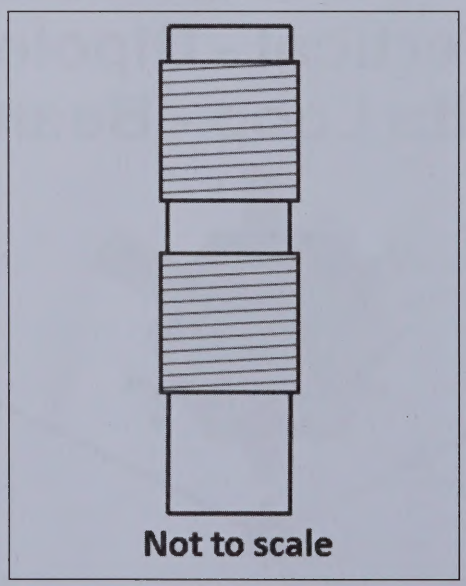


Figure 1—Two-winding loading coil.

In addition, I decided to use a two-part winding on a single form for the loading inductance for simplicity. One winding will resonate the antenna on 60 meters and a second winding will add enough inductance for 80. Alligator lead clips would be used to make the proper connections.

Some quick calculation using the online calculators in [2] and [3] give me the following approximate numbers for the two bands:

Frequency	5.3 MHz	3.56 MHz
Inductance	23 uH	56 uH
# of turns	50 turns	100 turns

These numbers are for a single winding. Since the two sets were to be separated, the additional turns for 80 meters would have to be increased. Plus, since the calculations are only approximate, the 60 meter winding was originally done with 60 turns and the 80 meter one with an additional 60 turns. The thought was that turns could be removed from each to achieve tuning at the desired frequencies. Figure 1 shows the basic idea. While nuts and bolts were used for winding connections on the sloper coil, this was not possible with this slip-on form. Instead the coil wires were to be stripped at the ends and looped though holes drilled into the form and made into loops for connection. This level of detail is not shown in the conceptual sketch.

The next step was to do some winding and testing. Proceeding methodically, I first wound the 60 meter coil and tested it by itself. As expected, I had to remove turns to get the right tuning. This was done one turn at a time and the remaining turns were held tightly in place with duct tape. So far, so good.

Next I added the 80 meter coil about two inches below the first one and used a clip lead to connect them in series. Due to bad weather, several days passed between the work and the testing. Finally I was able to put the coil form, wire and pole on the car and continue. Again proceeding methodically, I first connected only the 60 meter coil and checked the resonance curve. Somewhat unexpectedly, now the

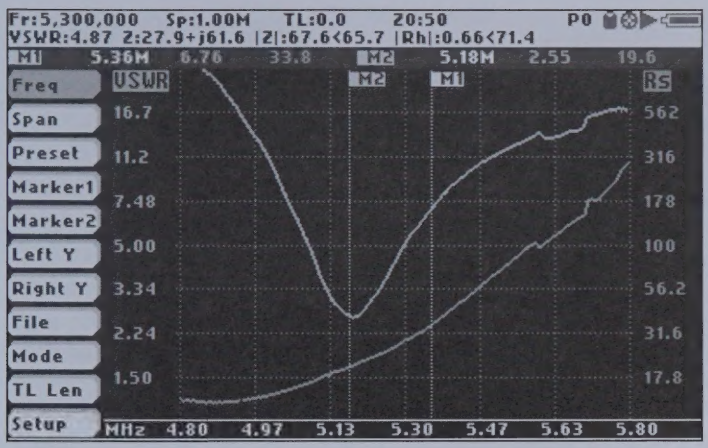


Figure 2—Field trial, 5.3 MHz sweep.

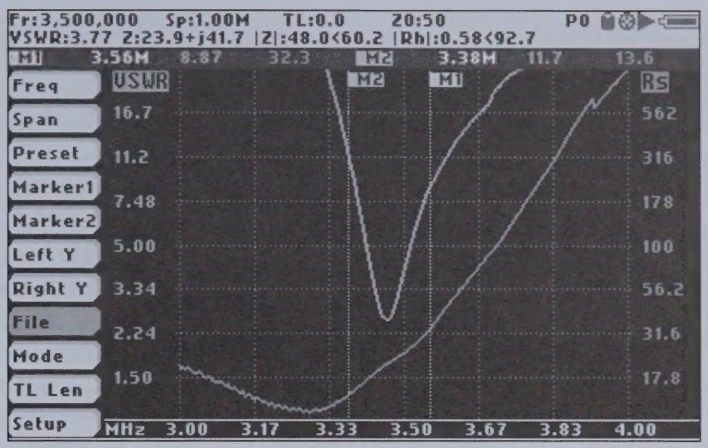


Figure 3--Field trial, 3.56 MHz sweep.

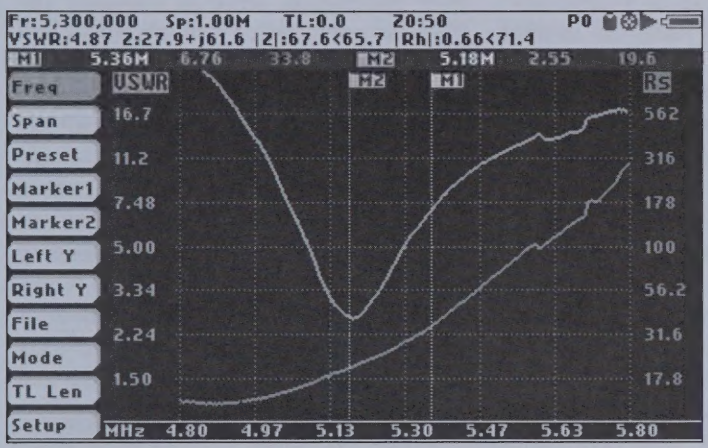


Figure 4—Successful 5.3 MHz sweep.

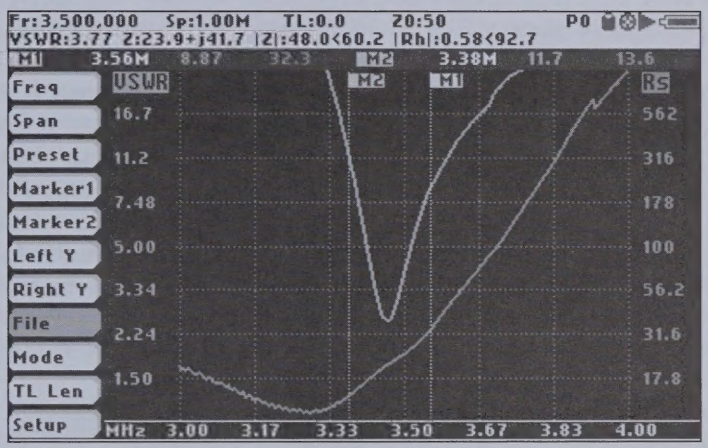


Figure 3—Successful 3.56 MHz sweep.

antenna tuned low in frequency so a couple more turns were removed to re-resonate it. Apparently, presence of the 80 meter windings had affected the first coil's inductance.

Then the 80 meter coil was slipped in and the antenna checked, and enough turns removed to bring the whole shebang on frequency. Mind you, at this point the coils were held in place merely by duct tape.

Now that all seemed well, the next action was to carefully remove the tape, drill some holes in the coil form to secure the windings and make the wire loops needed to make the proper connections. Feeling that all was well, I then took the antenna out on one of my POTA activations (Parks On The Air) to test it in the field—bad move! The right thing to do would have been to recheck the resonance frequencies under benign conditions.

As can be seen in Figures 2 and 3, the tuning had shifted well below the desired points. The SWR at 5.32 MHz was over 6:1 and on 3.56 MHz it was almost 9:1. The outing was not a total loss though, since I was able to keep my Elecraft KX3 transceiver happy using its internal tuner and, surprisingly, a half dozen contacts were made with two of them on 80M, in spite of sky-high standing waves and an output power of only 5W.

Back home the windings were reconfigured, and some additional turns added to both coils along with a couple of taps for in-the-field tuning. This time the duct tape was left in place. Another POTA outing confirmed that the tuning held, as can be seen in Figures 4 and 5. This time out another half dozen QSOs were made on 60, but none on 80 meters due to insufficient activity. RBN [Ref 4] hits on my signal, however, confirmed that the antenna was working on 80.

Now SWR values are under 3:1 at resonance and at about the correct frequencies. They are not as low as one might want, but unfortunately for a much-foreshortened skywire with low ground losses that's life. It is low enough to be easily

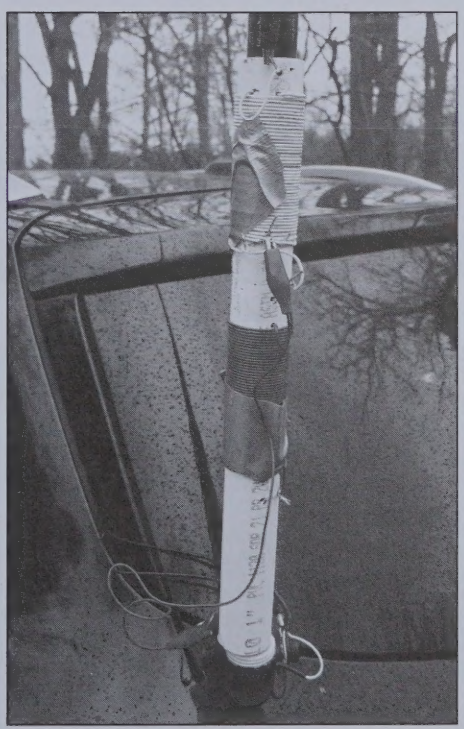


Figure 6—Ugly but functional loading coils.

tuned out with the KX3 internal tuner and not so high as to incur more than fractions of a dB extra loss in a short feedline.

Ok, that's not the end of the story. As this is written in early March, the weather is still not good enough to do much outside antenna work. When Spring comes along the loading coils will once again be cleaned up, reconfigured and their tuning verified. Meanwhile I will be out and about using the ugly but functional coils illustrated in Figure 6.

References

1. Joe's Quickie No. 107—Get on Down With Your Sloper!, Idea Exchange, *QQ*, January 2019

2. https://m0ukd.com/calculators/loaded-quarter-wave-antenna-inductance-calculator/

3. http://www.66pacific.com/calculators/coil-inductance-calculator.aspx

4. Reverse Beacon Network: http://www.reversebeacon.net/index.php. Volunteers around the world monitor and list the signals heard on the ham bands, telling when and how well they are heard.

—DE N2CX

Unconventional Keys and Paddles

From Howard Zehr, K4LXY, originally titled "Of pianos, typewriters and eyebrow tweezers: The tweezers paddle and more"—

I get a kick out of fashioning paddles and keys from ordinary and sometimes unusual materials. During a recent winter, for example, I entertained myself by making a straight key out of piano parts, shown in Figure 7. A microswitch provided the contacts and a piece of plywood the base.

Several years ago, at a local art gallery, my artist daughter and I had an exhibit entitled "The Secret Life of Typewriters" exploring typewriter parts in various media. My medium was photography. Obviously I had to make a key from typewriter parts.

For this, all I had to do was mount the ribbon mechanism on its side and add a microswitch as seen in Figure 8 (the wires had not yet been added to the switch). The roller serves as knob and the spring is built-in. The key is actually quite functional and I have used it on the air for SKCC activity.

Years before, when discretionary radio money was tight (or I was more of a cheapskate than I am now), I tried making a paddle from a clothes pin (Figure 9). It works but could use improvement.

Recently, when ragchewing with Bill, K4IBZ, he mentioned that he was using a homebrew iambic paddle made from a pair of tweezers. I was inspired. He eventually sent me a pair of tweezers like he was using, with buttons attached as paddles, and pennies on the backside as reinforcement. I mounted the tweezers on a small project box (Figure 10).

Two threaded brass spacers, bolted from underneath, serve as contacts. The tweezers are mounted with a vertical bolt near the joint (on the right). This spreads the paddles farther than I would like, so I added spacing adjustments using small terminals and L-shaped wires.

However, the version I really like uses heavier eyebrow tweezers with cutouts, purchased on eBay for a grand total of $3.55, including postage.

[*WA8MCQ note—he included an eBay reference which was no longer valid when I edited the article. However you can still*

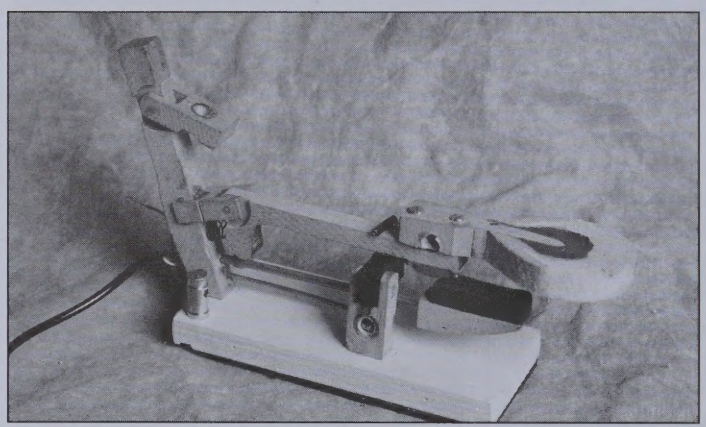


Figure 7—The piano key.

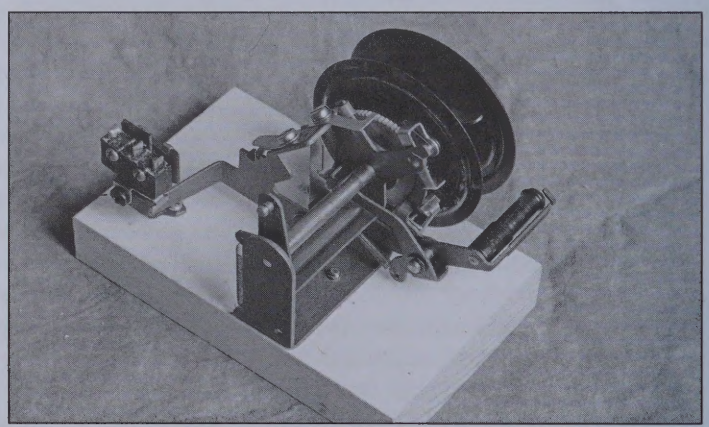


Figure 8—The typewriter key.

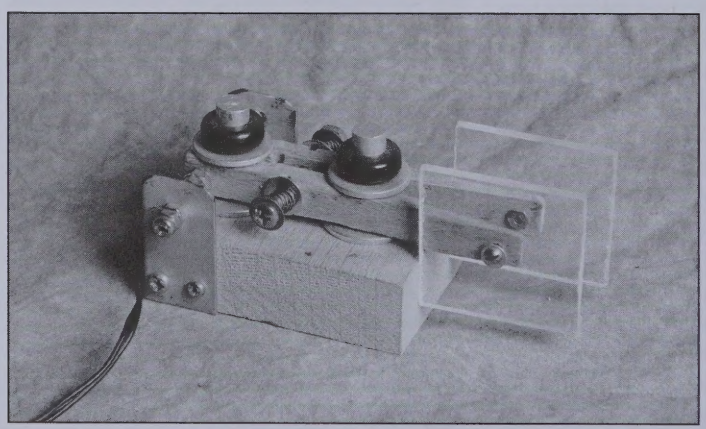


Figure 9—The clothespin paddle.

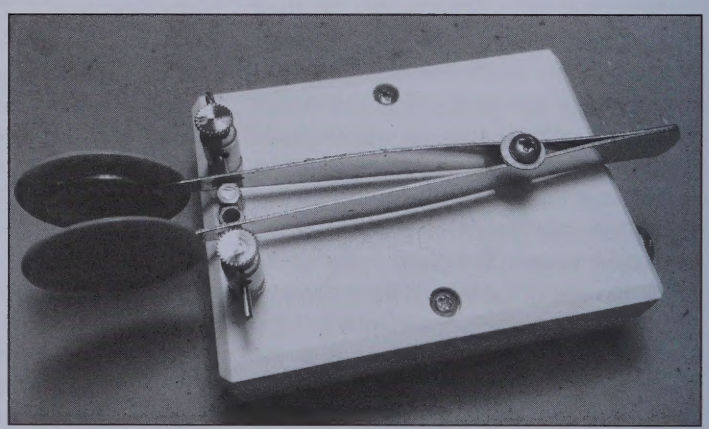


Figure 10—Tweezers paddle with buttons.

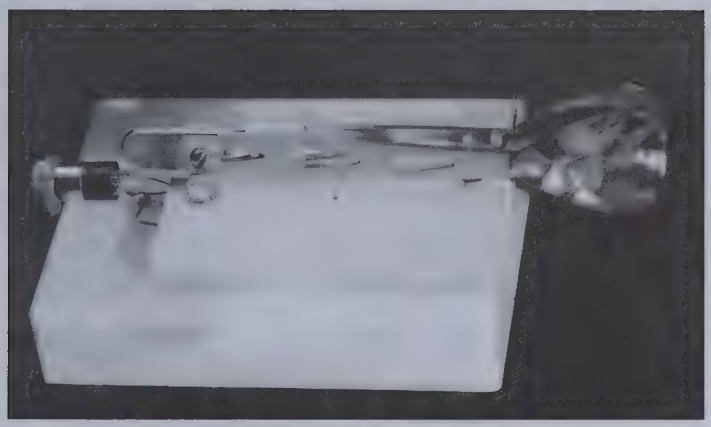


Figure 11—Eyebrow tweezers paddle prototype.

Figure 12—Tweezers paddle, final version.

find ones that look like his, with the cutouts, if you search eBay for the phrase "silver eyebrow tweezer slanted". That pulls up a couple of hundred results, some of which are this type and the prices are similar.]

Figure 11 is my first attempt, the prototype, mounted on a thin piece of plywood which is attached to a marble base. It is workable but not very elegant. A couple of small vertical bolts serve as contacts. Because the spacing is tight, they are offset so they don't make contact with each other. A piece of metal bent at right angles and inserted between the prongs near their joint can be slid back and forth to adjust the spacing. The pair of tweezers is mounted as described below, in my next version.

The final version, Figures 12 and 13, is the one I like best. In fact, I like it a lot! See the K4LXY entry on qrz.com for a color photo.

For paddles, I attached guitar picks using DAP RapidFuse glue (reinforced with epoxy). A small project box filled with fishing weights provides the base.

I had some small metal angle-pieces in my junk box, so used one on each side to mount it to the box. The small horizontal mounting bolt (far left) goes through an existing hole in the tweezers. I used an identical pair of angle pieces as contacts, screwing them to the base and separating them with a tiny space and tape so they don't make contact. Connections to these contacts are made underneath, inside the box.

The challenge here is the spacing. The space between the two tweezers blades is pretty small and doesn't leave much room for the contacts. I could have mounted the tweezers with a vertical bolt through the base, as in the earlier example above, and that would spread them further, but this also affects the tension. I compromised by putting a small washer between the two blades, held with a small bolt through an existing hole (second bolt from the left), and slid it back and forth until the spacing and tension seemed right. You can, of course, experiment with spacing and tension to get the feel you like.

Wiring is inside the box. I used a 1/8" stereo jack on the back for the cable. If you use fishing weights, just make sure you don't use so many that they short out the contacts.

The paddle has a surprisingly good feel. I keep it side-by-side with my Schurr and often go back and forth between the two.

What other ideas for paddle materials are out there? Maybe there ought to be a contest for the paddle made of the most unusual materials, or at least a website where examples can be posted.

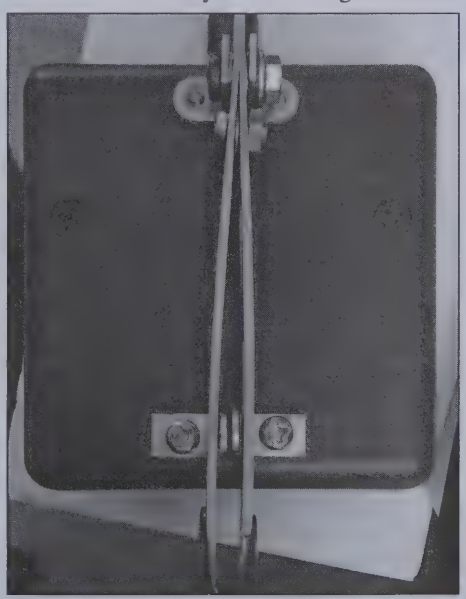


Figure 13—Tweezers paddle final version, viewed from above.

—DE K4LXY

Boost Converter for 14V Devices

From Dave Koberstein, N9DK—

The Elecraft KX3 transceiver operates down to a supply voltage of 8 V, but requires over 12.8 V to run full transmit power (12-15 W). More importantly, it requires 13 V to trigger the internal circuitry to charge nickel metal hydride (NiMH) batteries. Other amateur radio gear operates with similar bifurcated specifications.

The lower voltages are commensurate with battery sources, the higher voltages with bench supplies. What I want is the ability to drive my KX3 to provide all functionality via battery voltage levels, across the battery's range of usefulness, with the performance of a bench supply.

A typical case is to be in the field, perhaps car camping. From an external battery, perhaps the car's battery, I want to top off the charge of the KX3's NiMH batteries before heading out on a SOTA event (Summits on the Air). Or perhaps I'm operating QRP but could use an extra S-unit to finish a contact (bumping 5 to 15 W is 5 dB, or just under an S-unit).

[*WA8MCQ note—info on SOTA can be found at https://www.sota.org.uk/.*]

The common solution is to use a boost converter, and that's what I'll describe here. Being interested in field operation, my boost converter needs to be small and lightweight; in a word, portable.

I discovered some simple, small, off-the-shelf parts to create a lightweight solution with fixed output voltage of 14 V

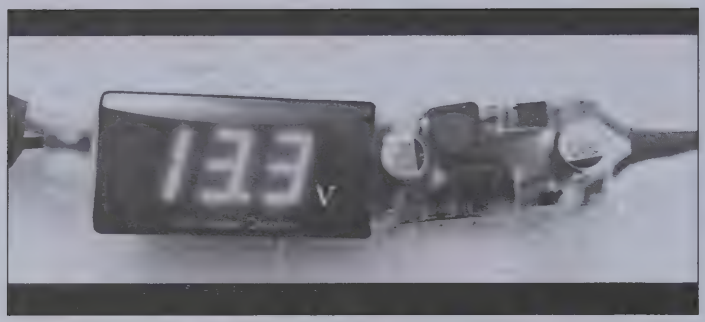


Figure 14—Voltmeter module and boost converter.

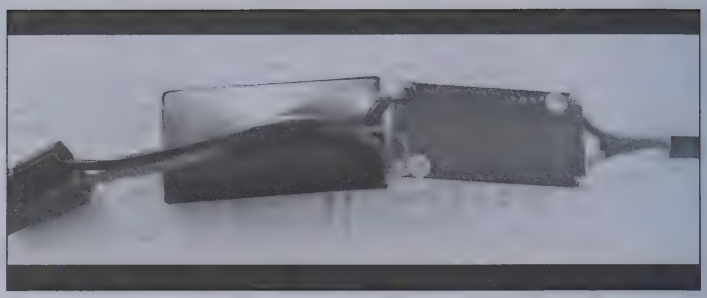


Figure 15—Rear of voltmeter and converter, covered with clear shrink tubing.

across a range of input voltages from 3 V to 15 V. Of course with a fixed output voltage, the input battery will be drained, and over-discharged, or until it shuts down without warning. This project benefits from a voltmeter on the input to track the battery voltage as it discharges.

Figure 14 illustrates, from left to right, the battery input, the source providing 13.3 V displayed on a voltmeter, the boost converter, and the output on the right. Not shown is the output voltage of 14 V.

The boost converter voltage is tunable with a trimmer potentiometer. After setting it, use a small amount of glue or nail polish to lock it in place.

The connectors I used, of course, are the ubiquitous Anderson Power Poles. A little bit of black heat shrink on the wires attached to the converter keeps them stable. The voltmeter is a small enclosed package, connected in parallel with the input. It is simply placed over the input wire.

Finally, the whole thing is encased in clear heat shrink tubing to keep it all together and hold the voltmeter in place. Figure 15 shows the back of the voltmeter placed over the input wire and held in place with the tubing.

While the tubing does impact the thermal profile, I do not observe significant heating of the assembly with 11-13 V input while either charging the KX3 batteries or operating up to 15 W (sorry QRP purists!) on CW or SSB. I only run higher duty-cycle digital modes with lower power around 5 W. Duty-cycle testing of this solution has been limited.

The size is quite small—about 1 inch by 3/4 inch in cross section and the weight is 1.75 oz.

I found the converter online at www.prodctodc.com; search for item #090440. The description is "25W power supply module/charging module DC 3~15V boost converter/adjustable voltage regulator DC 5V 12V 24V adapter." There are many other options both on this site and other places. You might choose a different device for your needs.

The voltmeter came from amazon.com; search for B07G57ZK3F. It's available in different display colors. I found the enclosed package to be simple to deal with.

Dave sent along this update later—

We used the converter for my son's science fair project. Unfortunately, the source was plugged into the output and the converter is no longer. Presented with the opportunity to update the choices, I discovered XL6009-based boost converters. It supports a wider supply range and the schematic of an implementation appears to include diode protection for reverse connections. I have not gotten the part yet so I don't have any photos. Go to amazon.com and search for "XL6009 converter".

—DE N9DK

No-Moving-Parts Straight Key

From Howard Zehr, K4LXY—

I take some pride in my CW, but only with a paddle and keyer; my straight key fist is fairly awful. Yet when I find myself tapping out CW with my fingers on my leg or a book, it sounds pretty good. I've often wondered whether a key-based finger action rather than wrist or arm action would help. This article describes a straight key that does just that.

The project started as an attempt to build the force-sensing paddle described by Art, K8CIT, in the February 2019 issue of *QST* (pp. 42-43). Art built his paddle around force-sensing resistors that are often used in self-leveling 3D printers and Arduino projects. I built his circuit but it wouldn't work on my Kenwood TS-590SG transceiver. Every time I connected the paddles to the rig, even without the battery, it would go into transmit.

Eventually I figured out that I hadn't made a mistake. Rather, the TS-590 doesn't require a perfect connection to key it; in fact, it will key with 30K ohms or more resistance across the key connection. When the power to the paddle circuit is disconnected, the internal resistance in the circuit is enough to key the rig. In the process of figuring that out, however, I broke the delicate connections on one of the force-sensing resistors. Since I had one sensor left, I decided to build a force-sensing straight key that would respond to finger tapping.

Because the TS-590 responds to a resistance across the key connections, why not connect the force-sensing resistor directly? That in fact works, leading to the simple key in Figure 16. I mounted the remaining force-sensing resistor on a base and connected it directly to the key input.

Figure 16—The first force sensing resistor tried.

Figure 17—Unit built with a smaller, round force sensing resistor.

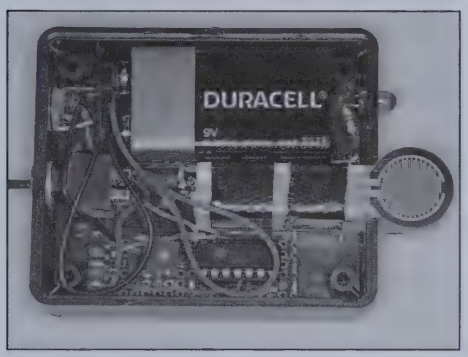


Figure 18—Inside the box.

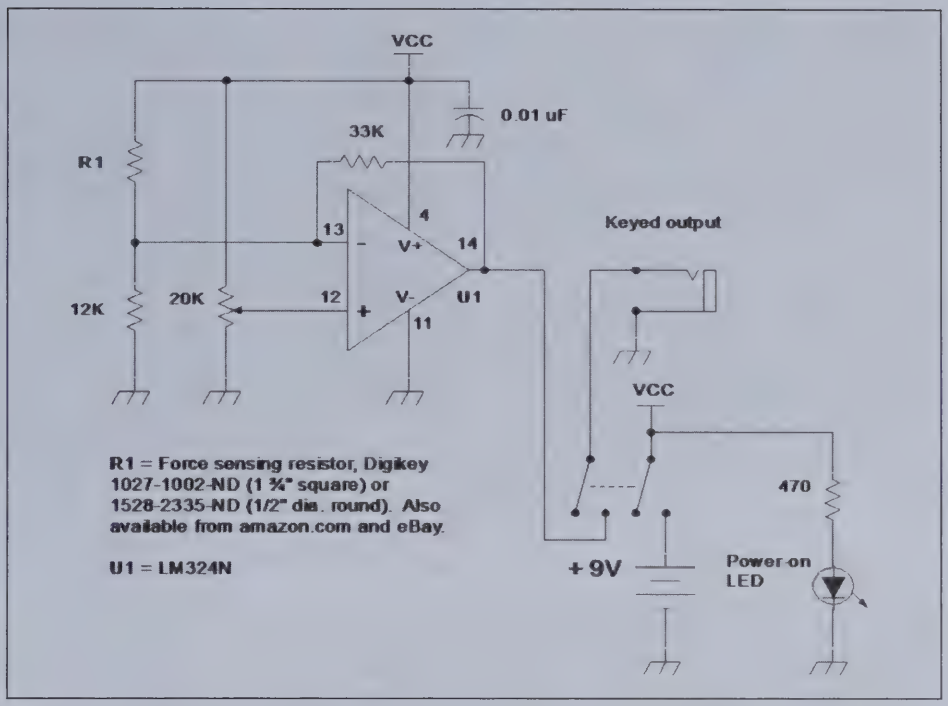


Figure 19—Circuitry inside the box. R1 is the force sensing resistor.

This arrangement probably won't work on many rigs and doesn't allow for adjustment of the touch pressure needed, but on the TS-590 it works pretty well. [*WA8MCQ note—according to the data sheet, the sensor is about 1-3/4" square.*]

I couldn't bring myself to give up the electronic version, so I ordered another force-sensing resistor, but this time a small round one that only accommodates one finger. The unit in Figure 17 was built around that although it would work just as well with the larger square sensor.

The design uses half of Art's paddle circuit with one addition: the output is disconnected when the power is switched off to avoid keying rigs like the TS-590 that will key with a less-than-perfect connection. It is built around the inexpensive LM-324N op-amp (I got 10 on eBay for under $4, postage paid). The force-sensor (R1) costs $6-13, depending which one you use and where you get it. Only a few other parts are required.

I used a 2-1/2 x 3-1/2" project box and could have mounted the sensor that serves as keypad on top of the box or on a wood base under the box, but I wanted it to protrude so I could get my fingers around it. Since I already had a hole cut in the side for the paddle version I tried to build earlier, I mounted the sensor on a wooden shaft that protrudes into the box (Figure 18). I built the circuit on a small double-sided PCB prototype board cut down to fit into one side of the box, and the 9V battery just fits into the other. It was a tight fit; if you want to mount the sensor this way, you might want to choose a larger box. (Figure 19 is the circuit of the box.)

Once you have it built, adjust the trimmer for the touch you want and so that the rig isn't keyed without pressure.

My straight key fist still isn't great, but so far it seems better than when using a standard key, and my wrist and/or arm don't tire so quickly.

—DE K4LXY

HP355C Attenuator Repair

Step attenuators are handy things to have for the workbench and test lab. The HP 355C (0-12 dB, 1 dB steps) and HP 355D (0-120 dB, 10 dB steps) are popular units that often appear at hamfests and other sources such as eBay. First appearing in the 1963 HP catalog, these 50 ohm devices are rated at 0.5 watt from DC to 1000 MHz and cover their ranges in 12 steps. (The earlier 355A and B were rated to 500 MHz.)

Figure 20 shows a pair of older C and D models on the left that are bolted together and connected in series internally to give a range of 0 to 132 dB. There are two BNC connectors on the rear, one on each unit. (This may have been a custom order. I checked the 355C/D in all the old catalogs on hparchive.com, which is not affiliated with HP, and this configuration did not appear to be listed as an option.) For single units, the connectors are on the sides (the far right is a newer version of the 355C).

The 355C and 355D disappeared from the HP catalog in the mid 2000s. An improved set of devices is the 8494, 8495 and 8496 family, with versions rated to 4 and 18 GHz (and in one case, to 26.5). They were introduced many years before the 355C and 355D were dropped.

Each 355C unit contains 4 sections, of 1, 2, 3 and 6 dB, which are switched in and out in various combinations by microswitches, operated by a camshaft which is seen in Figure 21. Although it should probably never be necessary to do so except out of curiosity, resistors and switches are replaced on the bottom side--the top cover can be removed easily on the older models by taking off the screws.

On the never version, what I thought

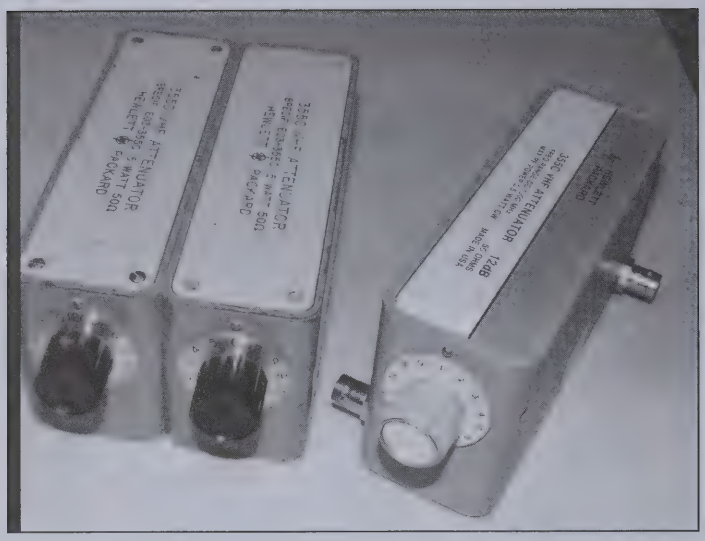


Figure 20—Some HP 355C and D attenuators.

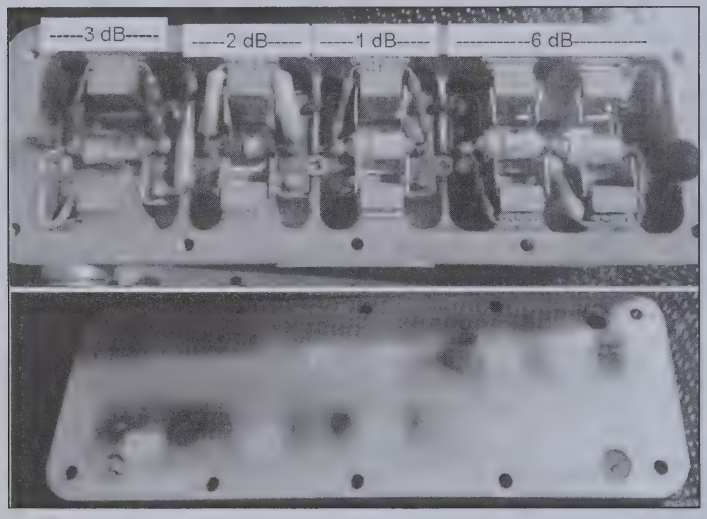


Figure 22—Inside a bad '355C.

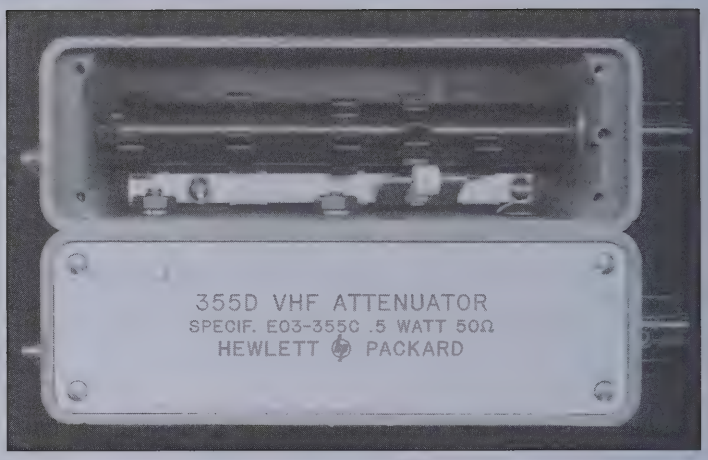


Figure 21—Inside the top of the 355C.

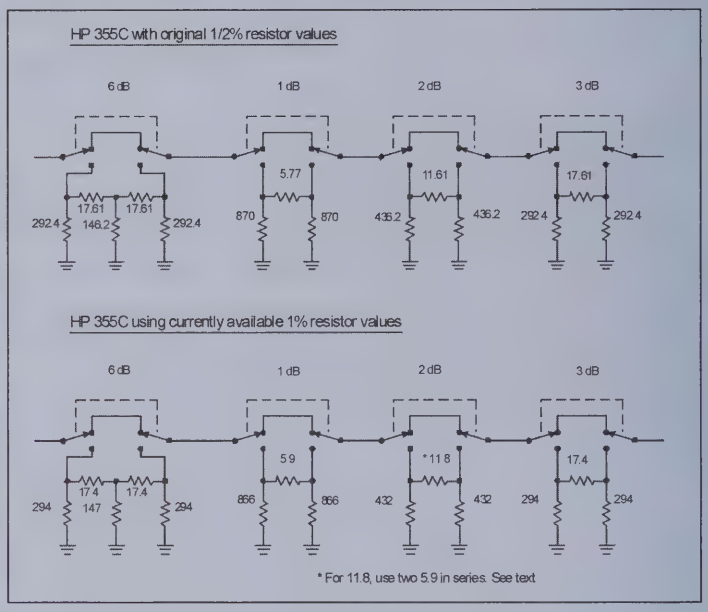


Figure 23—Original 1/2% and new 1% values.

was a label over the cover appears to be the cover itself, a sheet of aluminum apparently glued in place. After poking and prodding a bit I decided to leave well enough alone, to prevent possible damage.

Unfortunately attenuators are susceptible to damage, either from applying excessive power or accidentally connecting to a voltage source. Either way, the resistors that are switched in at the moment can get fried.

Prices for the 355C on eBay vary quite a bit but if you wait long enough you can pick many of them up for around $50 and sometimes less. Being an old cheapskate, I probably wouldn't pay more than that myself. Remember, these are older units and only rated to 1 GHz.

I picked up a 355C on eBay several years ago. I forget how much it cost but it was much less than $50 since it was listed as definitely bad. I looked inside to confirm that when I got it and finally got around to fixing it this year. (There was no rush since I already had a couple of them.) Several resistors had been overheated, and some appeared to be little more than hunks of charcoal with leads on them. Surprisingly, none were actually burned out completely. Figure 22 shows the underside with cover removed. Note the smoke marks on the cover.

Figure 23 shows the original and replacement values. The resistors used by HP were 1/2% values and are not readily available or cheap, but close replacements are sold by Newark (https://www.newark.com). They are 1% wire wound metal film, 600 mW—the MRS25 series made by Vishay. Minimum orders are quantity 10 per value, but they are not too expensive, a bit under ten cents each and less in larger quantities. They are stocked in their UK warehouse so it took a few extra days for them to arrive.

An online attenuator calculator can be found at:

https://chemandy.com/calculators/matching-pi-attenuator-calculator.htm

It can be used to design one or find the attenuation of an existing unit by plugging in the resistor values. You can use this to see the effect of replacing one or two of them with slightly different values and satisfy yourself that the change is minimal.

Important-read this before you remove any old resistors. Don't just wildly cut them out; you have to preserve as much of

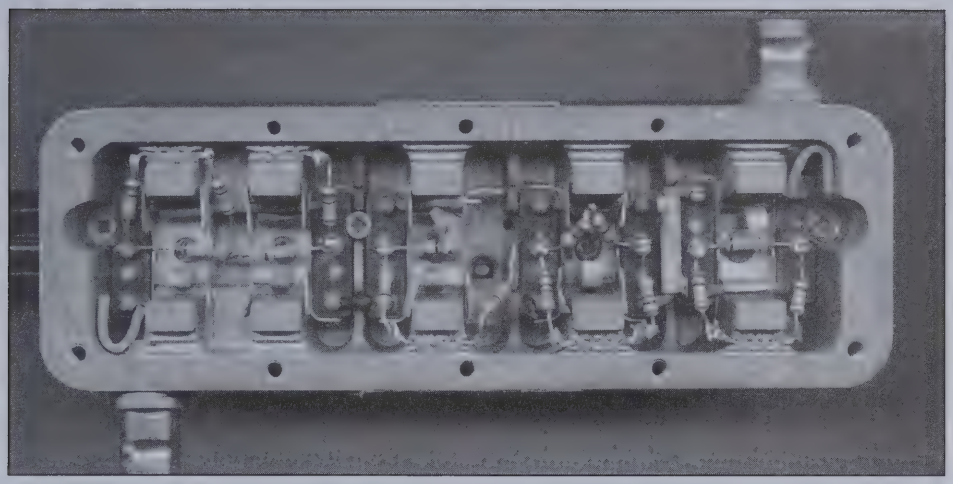


Figure 24—All new resistors.

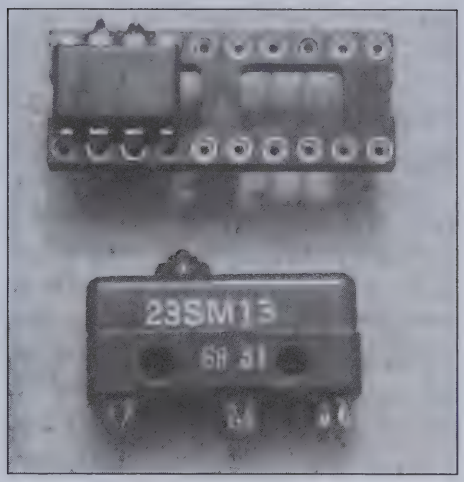


Figure 25—Microswitch used in the attenuator.

the grounded leads as possible, which are crimped in small channels in the frame (refer back to Figure 22). I used pliers to crush the resistors and leave the leads intact. The grounded ends of the replacement resistors are soldered to these wire stubs. You can ground them like the originals if you really want to, but this way is easier.

The alternative would be to drill a number of holes and mount several ground lugs. While there is nothing wrong with that, it didn't appeal to me. Space is limited and very small hardware would have to be used in some spots.

One resistor was 11.61 ohms. Available replacement values are 11.5 and 11.8 but neither was practical. I wanted to use a part with leads on it, and as high a power rating as possible. The 11.5 ohm leaded resistor had a minimum quantity of 1000. There was a 1% surface mount resistor rated at 0.5 watt, which was acceptable, but I really prefer to not solder leads onto those.

The 11.8 value had issues as well. The one with leads was on backorder, and cost almost $4 each (!) with a minimum order of 100. The solution was simple enough-use a pair of 5.9 ohm resistors in series to get 11.8. And that was a value that I had to get anyhow, as replacement for 5.77 ohms.

Figure 24 shows a 355C with all new resistors. The switch is missing from one position; it was removed to take a photo of it, seen in Figure 25.

In the unlikely event that one of the microswitches fails, you can replace it with a Honeywell 11SM3-T, currently $8.10 at Digikey. They carry various members of the SM family with somewhat different specifications and terminals, as do Mouser, Newark and Allied. Just about any one of them will be OK and price will probably be your main consideration. (Some have levers attached; don't get one of those. You would have to remove it before installing, maybe trim down the body a bit, and it would cost more.)

As seen in Figure 25, the switch removed from a 355C is model 23SM13. A couple of ICs and a socket are included to give an idea of the size. The 23SM series is obsolete but is the same as the current 12SM line. The ratings of the 23SM13 are 1 amp, 125VAC, 30 VDC. You do not need to duplicate those exactly; higher voltages and currents are quite acceptable. You also don't need to get something with exactly the same type of terminals as the original. Anything you can solder to will be fine.

The electronic test and measurement division of HP was spun off as Agilent Technologies in 1999, along with other things. In 2014 that division was spun off from Agilent as Keysight Technologies. (David Packard died in 1996, and Bill Hewlett in 2001.)

—DE WA8MCQ

The Fine Print

The usual rules apply; send your ideas and projects to me any way you can get it here (e-mail, snail mail, 3 1/2" floppy disk (if I can still find my external drive), CD, handwritten on a napkin, etc), or tell me where you found something good on the Internet. My addresses are 7945 Citadel Drive, Severn, MD 21144, and wa8mcq@verizon.net.

If you have something of interest and aren't sure just where it should go in the *QRP Quarterly*, send it to whichever member of the editorial staff you think is best, and they'll pass it along to someone else as appropriate.

Important note—when you send me something, you must get an acknowledgement from me. If you don't get one, either it never got here or I overlooked it. (Although very rare, both have happened.)

Well written, Pulitzer Prize quality articles are nice, as are computer drawn schematics, but don't worry if you can't do all that. We'll take care of the rest, editing, redrawing, etc. The readers are waiting!

●●

What does "QRP" mean to you ???

5W power level — Simple rigs — Homebrew and kit-building — A fun ham community

(Hmm... maybe <u>all</u> of these!)

10 Questions About Your QRP Operations

John Leonardelli—VE3IPS VE3IPS@gmail.com

The simple game of ten questions is a starting point to conversation and inspiration to use what other people are using. Please share with the other readers your answers by sending me an email with your answers. Get out and operate today! 73s, and Help! I need your answers for the next issue.

9H3FC/G4UDG Chris Fawkes

Q1 Favorite Mode: CW

Q2 Current QRP Radio: KX-3, KX-2, FT817ND, MTR5-B and various homemade QRP CW rigs.

Q3 Favorite Antenna: End fed half wave wires with ZM-2 tuner

Q4 What contests do I participate: Do not contest

Q5 My wish list: To operate from various countries around the world

Q6 Operating Tips: Have loads of patience, use headphones only

Q7 Do you use any tablets, smartphones, or laptops in the field? Small netbook

Q8 Batteries for Power choice: NIMH AA batteries (2x sets)

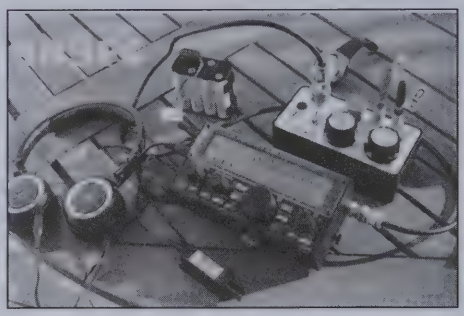
Q9 Smart phone apps: None

Q10 Do you pack a First Aid Kit out in the field? Very basic kit.

Best QRP Memory: Chris just spent a wonderful time in Malta and shares his trip report:

3 Watts of CW from Malta, EU-023

Our winter "getaway" this year was to Malta island (EU-023), as well as a family holiday. I always like to incorporate some ham radio activity, so a visitors license was applied for as 9H3FC, this was



granted by the MCA. With everything packed we set of for Manchester airport for the 3 hour flight, just a few hours later we were at our holiday apartment in the beautiful village of Mellieha, the rest of the day was chill time, the next day I awoke to find it raining very heavily, but in true ham radio spirit I went outside and erected the HF antenna, an EFHW (20M) inverted V, supported by a fiberglass 14-foot pole (SOTABEAMS) strapped to the pool railings (private pool) with counterpoise wire and tuned by my EmTech zm-2 tuner (the QRP GUYS tuner as a backup just in case !), I managed to find a spot out of the rain to operate and despite water beneath my feet I started to operate with 3 watts of CW from my KX-2 (running off 8 x AA Eneloop rechargeable batteries) and Palm "Pico" paddle key , the first reply from my CQ was from Milan, S58MU, with a 599 both ways, things were looking very good I continued to operate for the next four weeks when time permitted in between various holiday outings. It was not easy to send and write at the same time, I am right handed, this did slow me up a little bit at first but I soon got the hang of it, I prefer paper log books .A grand total of 534 QSOs were made into 56 DXCC countries, the "juicy" ones being BG8, RX9, NY3, JH1, VE3, 9J2, VO1, 4K6, TY7 etc. The longest distance being JA8EAT @ 9732 km. or 3244 km/watt!! A total of 59 2-way QRP QSOs were also made. The weather for the most of the time was excellent with 26C some days, so was nice to sit in the shade a work a little DX with my QRP station. To conclude, the equipment proved to be an excellent little DX station that packs down to very small packages for transporting, and running off rechargeable AA Eneloop batteries meant was not looking for an AC socket close enough to my operating position! Once again a most enjoyable holiday in the sun by the Med. Oh, and the ham radio was excellent!

Glen Johnsen, KA6GMA

Q1) Favorite Mode: FT8, CW, or SSB. CW is the mode of choice in this solar cycle environment.

Q2) Current QRP Radio: Elecraft KX3

Q3) Favorite Antenna: Use a 40 meter dipole and End Fed Random Wire. Depends on the location.

Q4) What contests do I participate: Participating in ARRL SSB Sweepstakes, ARRL RTTY, and straight key night

Q5) My wish list: Driving my ATV through the Arizona landscape, stop in random locations, and setup portable operations with my KX3

Q6): Operating Tips: Use designated QRP Frequencies SKCC, NAQCC, and QRP ARCI

Q7) Use a tablet, smartphone, laptop in the field: Location apps

Q8) Battery Choice: Powersonic PS1220 (12v, 2.5amp hour)

Q9) Smartphone apps: Google maps, US Topo maps, APRS Droid. I know my wilderness location and so does the XYL

Q10) Pack first Aid kit: Absolutely! Don't leave home without it.

Best QRP Memory: My first international contact using the KX3 and 5 watts, I worked Chile, CE1OEB, on SSB from LAX airport parking lot

N9DK Dave

Q1: Favorite Mode: CW, although I enjoy the digital modes such as FT8, as well; I wish I would spend more time on CW and restore my speed to what it was decades ago

Q2: Current QRP Radios: KX3 with 2m module

Q3: Favorite antenna out in the field: I use the EFT Trail Friendly from LNR

VP2V/N9DK/MM

precision; I pack arborist throwing line (great strength, weight, and slippery on bark) and an 11m carbon fiber pole weighing 1.25 pounds; for balconies and vacation operation, I use a Buddipole with a homemade clamp (significant thanks to KØXI) for a base

Q4: What contests do you participate in? I check WA7BNM contest calendar every weekend I'm free and try to make a few contacts in any mode; CWT; with KØXI leading the charge, we've mounted multiple serious 7QP adventures in remote county lines, Nevada; I join K6EI for every field but my CW isn't usually needed until the 4 AM shift! I love SOTA and tend to target anything unactivated I can reach—the California Sierras are great for this.

Q5: What is on your wish list? Making a portable FT8 setup as documented by OH8STN; a 432 transverter (Transverter Store) for VHF contesting; making an ultralight/small capacitance-touch paddle (based on TTP223)

Q6: Operating tips: Just jump in and try it; it doesn't matter if you make a mistake or don't make any contacts; did you setup an antenna and power on a radio? I've had many failed adventures (zero HF IOTA contacts while NA-023, total failure at W6/NE-210), but had a blast trying

Q7: Do you use any tablets, smartphones, or laptops in the field? My first filter is weight; my phone (see Q9 for apps) always comes with me; sometimes tablet for logging; laptop on all vacations; QRPWorks sidecar, although I haven't gotten smooth enough to send/receive CW and work the buttons

Q8: Batteries for Power choice: I use the KX3 battery option with NiMH—quick to setup, pack up, and light. I've got a 7.5 Ah LiFePo for car camping and a Harbor Freight jumpstart battery pack with lighter sockets

Q9: Smart phone apps: GPS Test; Heavens Above; PeakBagger; PeakFinder; SOTA Spotter; *QST*; Zinio (for *CQ Magazine*)

Q10: Do you pack a First Aid Kit out in the field? Yes, I have a small one with only the most basic ingredients; I'm always worried about weight, but should probably have a bigger/better kit.

Brian VE3GMZ

Q1: Favorite Mode: I use CW, SSB, RTTY, PSK, FT8, APRS and FM (if that counts including Dstar)

Q2: Current QRP Radios: KX3 is my only rig plus a TH 74A on VHF/UHF

Q3: Favorite Antenna out in the field: My easiest ant to work with is an EFHWD (40-10 Par EnFdz) with a Spiderbeam flag pole. I have also had great success with a 40-10 Alpha antenna Loop. Last on my list is a Buddipole which I find fussy and often frustrating—I also have an ELK periodic log yagi for VHF/UHF

Q4: What Contests do you participate in? Whatever and whenever I can sit down for an hour or two—contacts are easy and plentiful no matter the mode—it's just a fun thing to do. Not a serious contester; I'm not very skilled

Q5: What is on your wish list? More skill/knowledge

Q6: Operating tips: Be patient

Q7: Do you use any tablets, smartphones or laptops in the field? For me in the field is defined as at the cottage so yes—I use a laptop

Q8: Batteries or Power choice: I have a Bioenno pack and also the AAs in the KX3 plus usually I'm just on AC with a plug in

Q9: What smartphone apps do you use? Not many—RF finder, APRSdroid occasionally, Echolink occasionally, pRxTx for monitoring, and the Repeater Book, and a few streaming sites for aero etc

Q10: Do you pack a First Aid kit out in the field? I havent ventured anywhere but one day ...and I will.

Best QRP Memory: sitting outside at the cottage with my KX3 @5w and Buddipole working someone (SSB) flying a 727 at 35000 feet over the mid-western states... and no QSL to prove it! But my nephew will verify it happened because he was there :-)

George G3RJV

With great sadness, we note that the founder of the GQRP Club and Amateur Radio author the Rev. George Dobbs, G3RJV, of Littleborough, England, died on March 11. He was 75... He was the honorary secretary of the GQRP Club (G5LOW), which he founded in 1974 to cater to those interested in low-power Amateur Radio communication.

Many of us QRPers have built his circuits or read his wealth of information that made us better operators and builders. He will be greatly missed.

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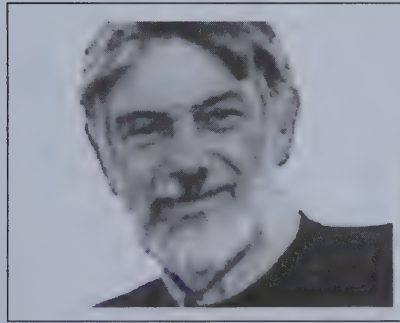

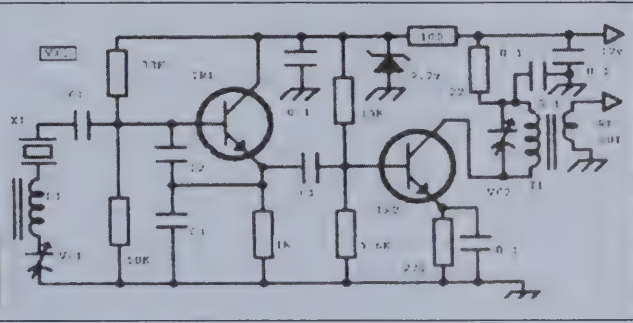

A Remote Field Strength Meter

Bob Rosier—K4OCE

In my recent article on the Cubical Quad (QQ Oct. 2018, p.19), I mentioned using a remote Field Strength Meter to make some of the measurements. This was the only method I found to fine tune a Cubical Quad. There are a lot of advantages in being able to check field strength using a detector located at a distant point. I recall a time that I had an old transmitter that I had tuned up the old fashion way by dipping the plate current. I discovered that I was not actually getting maximum output power. There was a problem in the final Pi tank circuit, and I would never have found the problem without the field strength measurement. In other word, before this measurement, I didn't know I had a problem....HI.

In another case, I received a 40 meter add-on to my Cushcraft X-9 beam as a birthday present. I still had my 40 meter dipole, so I decided to compare the two. I was a bit surprised to find that the new shorter add-on measured a little higher radiated power than the standard dipole. The computer modeling software Cushcraft used must have effectively added some form of a director to the shortened rotating dipole. When comparing antennas, you can always get an on-the-air report, but a field strength meter reading is far more accurate. Keep in mind, that antennas do not amplify power, they just concentrate (direct) it in a given direction. I have since taken down my wire dipole.

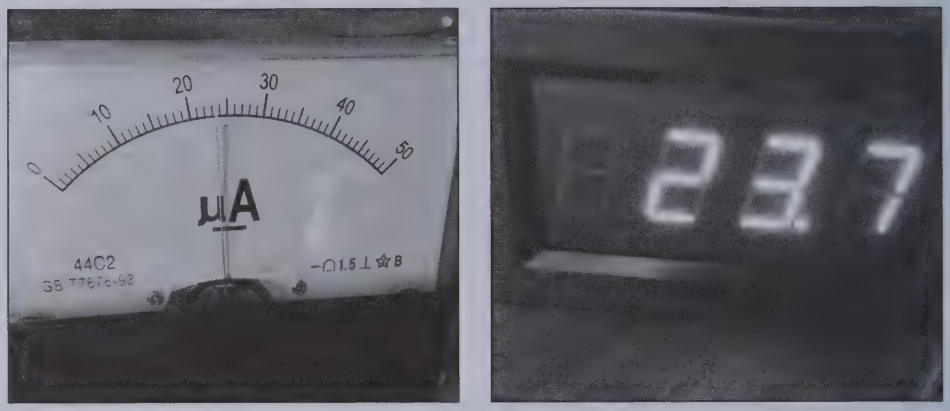

Figure 1—Measurement on both analog and digital meters closely agreed.

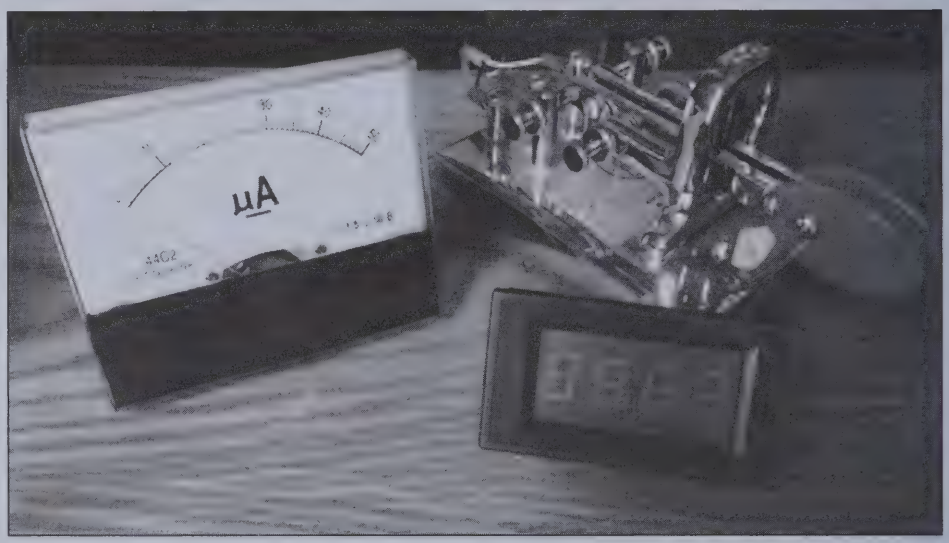

Figure 2—Size comparison of the meters, with a paddle for reference.

I wanted the field strength unit to be passive if possible. To accomplish this I used two collapsible universal AM/FM antennas made up like an adjustable dipole. They each collapse to about 6 inches and extend out to about 36 inches. For VHF and UHF you can adjust these collapsible antenna to the actual half wavelength. For HF, the antenna should be open to maximum length since in this case you are just trying to pick up as much RF as possible. I used 1N34 germanium diodes in a full-wave diode bridge arrangement (1N270 will also work). Although in most applications the silicon diode are superior (higher voltage and current rating, much less reverse current leakage, can handle more reverse current, and are less temperature sensitive), germanium diodes have the advantage of having a lower threshold voltage and lower voltage drop. Silicon needs about 0.7 to 0.8 volts across it to conduct, whereas germanium only needs 0.2 to 0.3 volts. As you are probably aware, the full wave arrangement results in a higher DC voltage output as compared to a single diode. I decided to use a 50 microamp (uA) meter for maximum sensitivity. I found a large size 50 microamp meter on line (about 4" x 3-1/8") for $5.19 and also found a digital version for $7.45. With the transmitter output power set around 5 watts, the analog meter read about 24 uA and the digital read 23.7 uA as can be seen in the pictures. So, the two meters tracked well. At the 1 watt transmitter output power level, the reading was 8 uA.

You can see the meter size comparison in the picture with my key. I thought I might have to add some addition filtering for the digital meter, but the chokes and bypass capacitor did their job and I got a steady digital reading.

I wanted a metal housing, so I used a 2.5" x 2" x 1.5" box that I already had and after construction I use a gutter sealant to make it waterproof (I used Geocel Gutter Sealant 2320 that fits a standard caulk gun). Now being waterproof, I stuck it up in a tree and to reach the point I wanted, it took 140 feet of wire. You need to orient the pickup dipole to the same polarization as the antenna under test. I mounting it broadside in the direction of my all band dipoles. Turning the field strength meter antenna vertical caused the ham shack

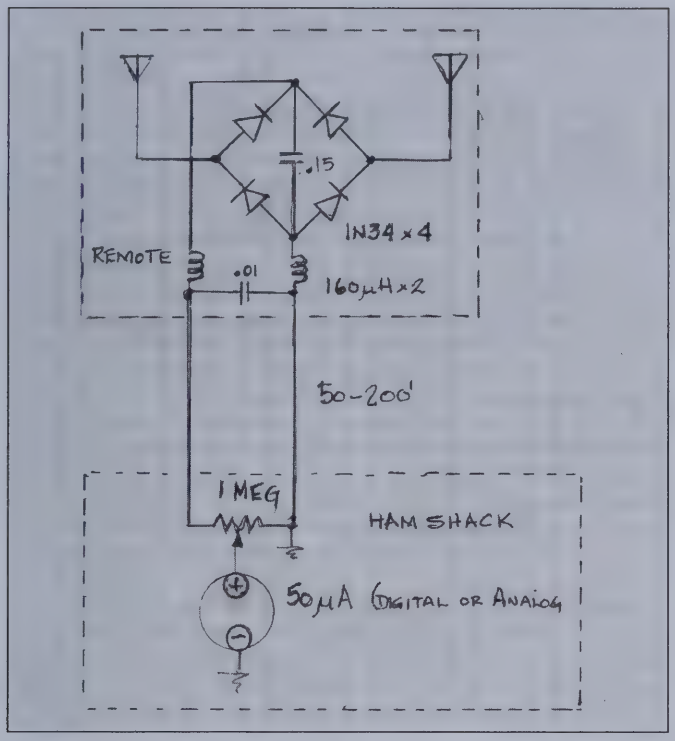

Figure 3—Circuit diagram of the Field Strength Meter.

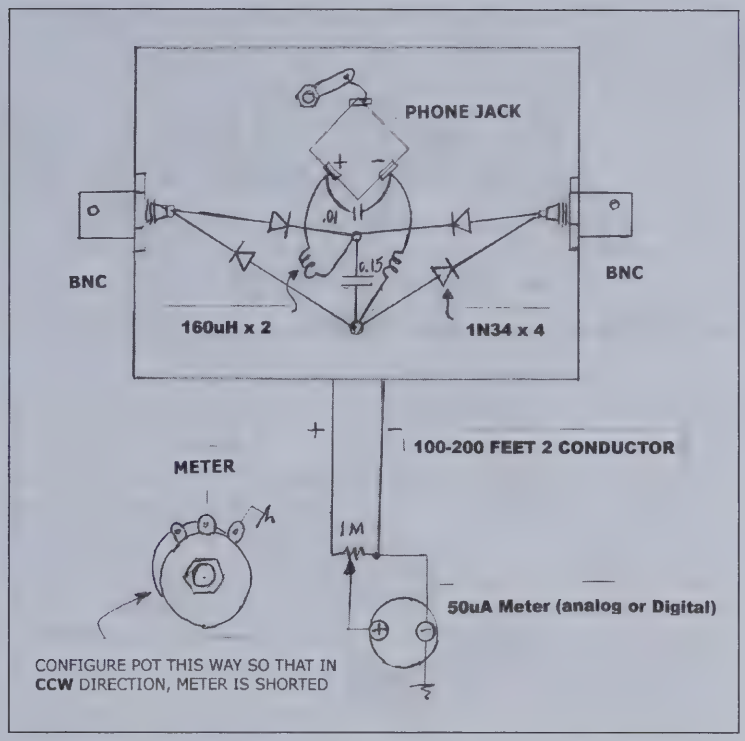

Figure 4—Pictorial assembly drawing.

meter to drop zero. The center of my dipole was on a pulley to the top of the tower. The beam, of course, can be turned towards the field meter.

You can turn the beam to measure the pattern as well as front-to-back and front-to-side ratios. The circuitry is simple because you are not trying to get an actual number in your reading; it is a relative measurement. If you permanently mount the remote detector, you can use an attenuation on the transmitting signal side, and calibrate the meter in dB. I have an attenuator I built that has 1, 2, 4, 8, 16, 32 dB steps (perhaps a future article). Six resistor T-pads and six switches allows you to drop power down from 1 to 63 dB in 1 dB steps. I found that in my setup, 2.5 uA was equivalent to 1 dB, so I could adjust my meter to full scale, then mark 1 dB steps zero being 20 dB down. All-in-all I am very pleased with the results, especially getting a good reading at the low 1 watt level. Here is the simple schematic and picture of the unit.

I had the 2 BNC telescoping antennas in my junk box, so this made for an easy way of mounting the antennas. With such a sensitive meter movement, it is important that you always keep the meter potentiometer set fully CCW when not making measurements. This places a short across the meter. The parts located at the ham shack consists of only a 1 meg potentiometer and the meter.

None of the component values are critical, so you can substitute any values close to the ones I chose. The 160 uH chokes were what I had in my junk box, but any value in the 100-200 uH range will work fine. In the diode bridge you can also use the 1N34A. Only difference is that the 1N34 is ceramic, and the 1N34A is glass.

A nice weekend project!

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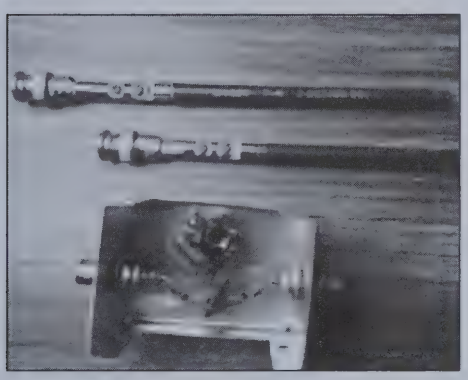

Figure 5—Telescoping antennas and the assembled unit.

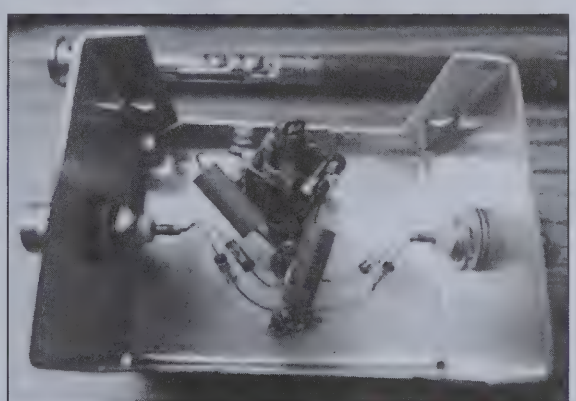

Figure 6—Closer view of the inside.

ANNOUNCING:

FOUR DAYS IN MAY 2019

May 16-19, 2019 • Holiday Inn • Fairborn, OH

Information: www.qrparci.org/fdim

QRP-ARCI's FDIM 2019 is in the works. Register NOW!

Get it on your calendar now! Thursday-Sunday, May 16-19, 2019.

If you haven't attended before, this is a great year to make it your first. QRP ARCI is sensitive to the first-time attendee and will try hard to make your first FDIM as fun and interesting as possible. We also make an effort to provide spouse activities.

We will again be at the Holiday Inn, Fairborn, OH. Reservations are available now through www.QRPARCI.org. Remember, all discounted hotel rooms are released only through QRP ARCI.

Registration and getting acquainted begins on Wednesday evening. Seminars are most of the day Thursday, with "meet the speakers" and an open room for some casual show and tell and plenty of time to swap tales that evening. Most of Friday daytime is open to attend the Hamvention and visit the QRP-ARCI Toy Store. Friday evening activities usually include "show and tell", vendor displays and maybe a judged home brew contest. Most of Saturday is again open for the Hamvention, and we have a great social event, banquet, awards presentation and door prizes that evening. Sunday is the Hamvention, and check-out.

Most of the speakers for the seminar have been contacted and confirmed. We'll have a "meet the speakers" social gathering after the seminar, where you'll have an opportunity to meet, question and discuss QRP with the speakers.

Don't miss out on the show and tell. You can to bring out your QRP related projects and put them on display. Your contemporaries will have a chance to roam through the displays and see the excellent craftsmanship used in these special exhibits.

It shouldn't surprise you to find a contest or two during the weekend. We've had QLF, split paddle, CW and other fun activities in the past.

We're lining up vendors for the vendor showcase. One evening, there will be several vendors with QRP related products displaying their wares. Many will offer special FDIM discounts.

In the past, the hotel has been accommodating with discount meal tickets. You'll find fast food restaurants across the street from the hotel.

This is preliminary information. A complete schedule and list of activities will be posted on the web site as we move through the process.

FDIM Dates:	16-19 May, 2019
Location:	Holiday Inn, Fairborn, OH (Hotel reservations only available through QRP ARCI!)
Seminars:	Thursday, 16 May
Club Night:	Friday, 17 May
Show-n-Tell:	Friday, 17 May
Buildathon:	Friday, 17 May
Banquet:	Saturday, 18 May (lots of prizes!)

Questions or comments

Norm Schklar, WA4ZXV, FDIM2019 Chair
fdim@qrparci.org

FDIM 2019 Homebrew Contest and Show-and-Tell

Friday, 17 May 2019, 8 to 10 PM

As in the past, we intend to allow entries in the Homebrew Contest to be displayed in the Ballroom on Club Night, Friday night, May 17, between 8 PM and 10 PM. To enter an item in the contest and insure that it is part of the voting (on Friday night), you must register your item on Friday night between 7 PM and 8 PM. A registration table will be outside the main Ballroom at that time on both nights.

FDIM 2019 Buildathon— by Rex Harper, W1REX

Friday, 17 May 2019

So this year, the FDIM Buildathon with be a little different. We will build a simple little O*Scope FUN! board for generating nice predictable signals to measure while we learn how to use a pocket oscilloscope... a little build time... and a little learning time! The price is a little higher for this FDIM as everyone will leave with *both* the O*Scope FUN! learning board and a very nice JYETech DSO Shell pocket oscilloscope. The scope sells for $39 at Circuit Specialists, but I have made arrangements with them to get the scopes at a reduced cost in order to keep the Buildathon price at $50.

Rev. George Dobbs, G3RJV, SK

Dick Pascoe—GØBPS dick@pascoes.plus.com

George Dobbs, G3RJV, 1944-2019

It is with great sadness that I have to report the passing of my dear friend Rev, George Dobbs G3RJV. George had had dementia for a quite a while. He broke his hip in a fall whilst in Wales around spring last year and was taken to the local hospital where he was given a new hip. He did not recover well from that and he was then moved to a care home on his return from Wales. He lived there, quite happily for a while, but was taken into hospital on 8 th March this year with breathing difficulties. He had pneumonia and an infection. The antibiotics didn't work and he died at 0400 on Monday 11th March . His wife Jo-Anna was at his side when he died.

George was known throughout the Amateur Radio world as 'Mr QRP'. Whoever met this diminutive, big bearded man was soon taken under his spell.

He is also known for founding the G-QRP club in 1974. I first met him just ten years later in 1984 when he came to my local radio club to give a talk. A couple of years later Kanga Products was born and a close working relationship with George started, him designing small QRP kits for us to sell.

During a conversation with him in 1989 at the first QRP convention he suggested that I join him and travel to Dayton, USA for the Hamvention taking our kits. This was one of dozen or so trips to the USA I shared with George, usually staying over a few days and exploring the countryside.

As a regular speaker at FDIM George was the only one that was booked in at every event. Other speakers revolved around George. Whenever he stepped up to the dais the room filled, usually standing room only. He not only spoke with great knowledge but entertained everyone too.

In 1992 the club President Paula reinstated the QRP Hall of Fame, who was the first non-American inducted? —George, along with Doug DeMaw, Roy Lewallen and Randy Rand. Five years later I discovered that my own induction was proposed by George.

One small claim to fame is that George and I even shared a double bed a couple of times when travelling to Friedrichshafen in the aptly named German village of Kippenhausen. My wife and I shared holidays with George and Jo, including visits to Prague and a couple to Ireland.

Anywhere you go around the world in QRP circles everyone knew George G3RJV. Our hobby became better known because of his writing and talks at clubs and his attendance at conventions around the world.

The loss of Rev, George Dobbs G3RJV to our QRP community is enormous; it will be felt throughout the QRP world. ●●

FDIM 2019 Presentation Schedule:

9:00-9:45	Jerry Wolczanski, KI4IO	"Building a Direct-Conversion Transceiver—My Journey"
9:50-10:35	Rick McGaver, NK9G	"Quartzfest"
10:35-11:00	Break	
11:00-12:00	Hans Summers, GØUPL	"Challenges of SSB: the development of the QSX all-mode HF transceiver kit"
12:00-1:30	Lunch	
1:30-2:30	Dave Cripe, NMØS	"Reinartz and the Radio Boy"
2:30-2:45	Break	
2:45-4:30	Joe Everhart, N2CX and George Heron, N2AB (3 topics):	"Portable QRP Antennas" "Home-brewing a Shack" "Arduino-based Audio Analyzer"
4:30-5:15	Jack Purdum, W8TEE	"Morse Code Tutor"

A Day in the Life of a Tuner Design

George Fuller—KXØR kx0r@arrl.net

From the SOTA Forum: http://reflector.sota.org.uk/t/a-versatile-tuner-for-sota-activations-by-kx0r/19748/16

Numerous tuner designs are available, and endless possibilities exist for combining tuners and antennas to use for SOTA. My tuners have evolved through experimentation and modification. I want to share my current tuner design, so other SOTA activators may enjoy the benefits of similar tuners. I've had consistently good results using these tuners. This is intended to be a manual to share what I have learned.

This is a detailed, technical piece, intended mostly for "makers" and more creative activators, who enjoy building and using their own tools on the summits. My drawings are crude, but the content is powerful.

We recognize these key points:

1. Most portable radios require an impedance near 50 ohms at the antenna port.
2. Most real antennas don't present an impedance of 50 ohms at frequencies we use
3. A tuner is a device to change the impedance of our antenna to about 50 ohms
4. A tuner performs complex functions to transform the antenna's impedance
5. We don't need to understand the mathematics of impedance matching to use a tuner
6. We do need to understand the basic concepts of what a tuner does to use it effectively
7. Mathematical theory, involving complex variables, is required to understand impedance-matching devices
8. Tuners can be modeled with available software
9. Some key intuitive concepts can take us far enough that we can make successful tuners
10. Bench experiments and field tests can yield acceptable results
11. An antenna does not have to be resonant in order to radiate effectively at various frequencies

The impedance of any antenna can be expressed as two variables: resistance R and reactance X:

$$Z = R + jX$$

where Z is a complex number, and j = SQRT of –1.

In order to change the actual Z of the antenna to a simple resistance of 50 ohms, our tuner must do two things:

1. Change the antenna's actual R to 50 ohms
2. Supply an opposite reactance to cancel out X

To match an antenna's complex impedance, ideally, we could do this procedure:

1. Measure the complex impedance with an analyzer
2. Design a network of L and C components to transform the impedance to 50 ohms
3. Build the network and test it—verify that the impedance has been transformed to 50 ohms

For our antenna to work on several frequency bands, we would analyze the antenna at various frequencies of interest, design and test matching networks, and then configure and package the matching device(s). We might decide to change the antenna as well, leading to more work.

With so many choices in the process, we might spend a lot of time and effort trying to come up with a practical antenna and impedance-matching device that would work well in the field.

Faced with this tricky puzzle, many ham operators take shortcuts in order to get on the air more quickly:

1. Purchase a ready-made "solution", often an antenna with a broadband matching network
2. Purchase a limited manual tuner with some attractive features
3. Purchase an auto-tuner
4. Use an antenna they think is 50 ohms—but usually isn't!
5. Try some other clever tricks that others suggest

The results vary greatly, but if radio contacts happen, many operators continue to use their compromised equipment, unaware of what they're missing.

A different approach is presented here:

1. We accept that antennas are mathematical functions, in which R and X vary with frequency
2. Voltage and current are not usually in phase at the feedpoint, i.e., the load is a complex number
3. Voltage and current may vary over a great range of values at the feedpoint
4. We don't know what Z is, but we won't analyze our system in detail, only very generally
5. We create versatile networks of components that can transform a wide range of complex impedances
6. We include enough variables in these networks that we can achieve a desired match in a few seconds
7. We include a device to indicate visually when we have a match, i.e., the feed impedance is 50 ohms resistive
8. We learn to use these devices in the field and make improvements over time
9. We accept that our tools include compromises, so we need to be aware of limitations

Impedance-matching devices consist mostly of inductors and capacitors combined in various configurations. Many popular circuits have been developed, all with various trade-offs in performance. We must decide how much complexity we can tolerate in order to get the performance we want.

My original design goals:

1. Multiple bands: 40-30-20-17M
2. 50 ohm input
3. 10W RF power
4. Match 25-5000 ohms resistive
5. Match wide range of reactance
6. Optimize for unbalanced loads, end-fed wires, etc.
7. Also use with balanced loads, dipole, loop, etc.
8. Minimal size—weigh a few ounces

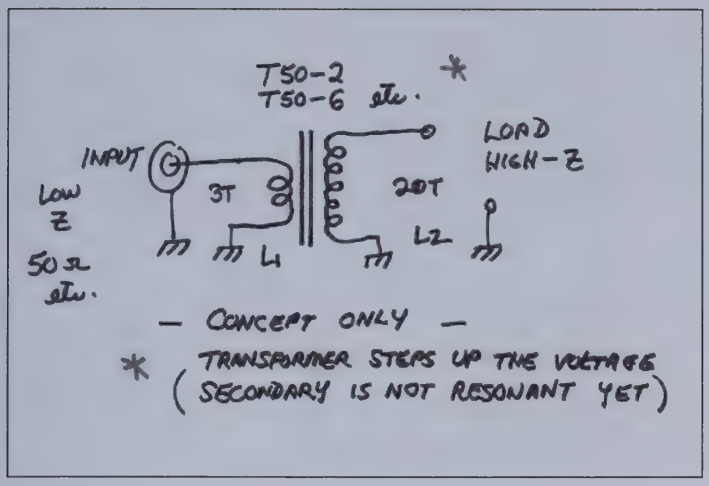

Figure 1

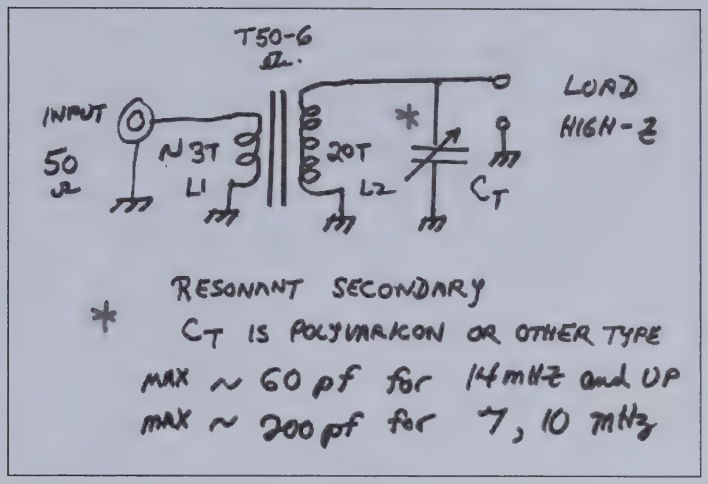

Figure 2

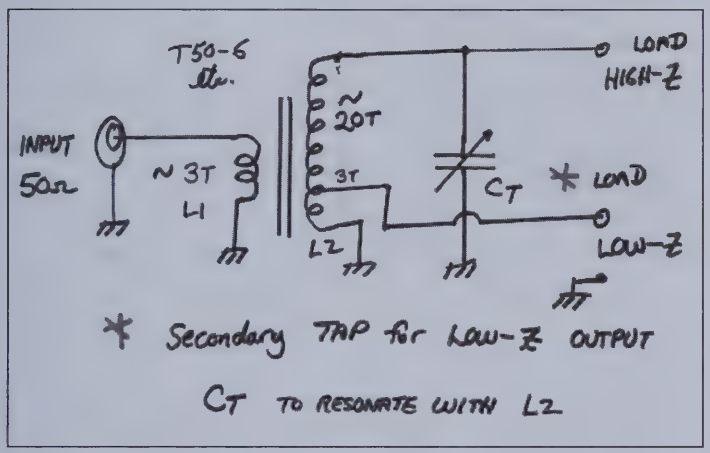

Figure 3

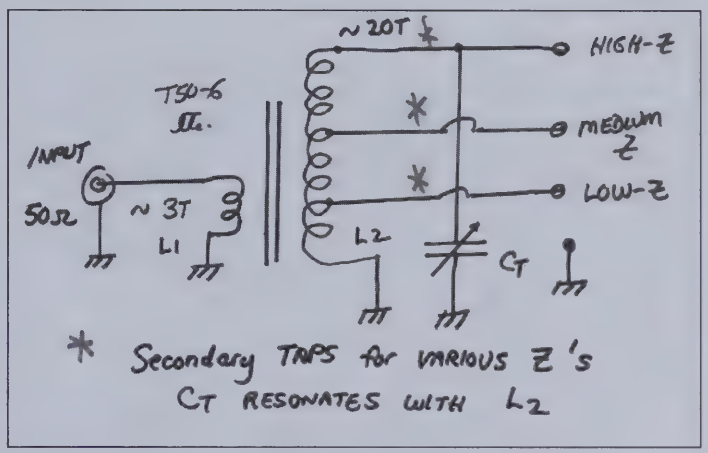

Figure 4

9. Low cost
10. Durable enough for SOTA activations
11. Accurate visual indication of 50-ohm match
12. Use with counterpoise or not
13. Good efficiency
14. Use for SOTA activations in the Rocky Mountains of Colorado

NOT Goals:

1. Cover the entire Smith Chart
2. Simple and easy to use by others
3. Foolproof
4. Minimize cost
5. Design for production
6. Tune automatically
7. Digital or remote control, etc.

Next, I show a series of concepts progressing to a practical tuner topology. The end result is relatively complex, but it provides plenty of performance in a tiny package. Most of the lower-cost alternatives are simpler, with fewer features, but they may perform OK, if you stay within the constraints of their designs.

Basic Resonant Tuner 0 (Fig. 1).

A conventional transformer is wound on a powdered-iron toroid core. This increases the impedance from 50 ohms to some higher value, depending on the turns-ratio of the windings L1 and L2. This is the basic concept of all the tuners included here.

Basic Resonant Tuner 1 (Fig. 2).

A variable capacitor across L2 is added. This allows parallel tuning the secondary, so that it can correct some reactance presented by the high-Z load. The impedance step-up can be adjusted by changing the turns ratio of the windings L1 and L2. The turns shown are just examples, concept only.

Basic Resonant Tuner 2 (Fig. 3).

A tap is added to the secondary winding, so that a lower voltage can be selected for a second output connection. This is for a much lower-impedance load. The impedance output of the new tap is controlled by its position on the winding. Position shown is just an example.

Basic Resonant Tuner 3 (Fig. 4).

More taps are added to the secondary, so that a greater range of impedances can be matched. These outputs may be connected to separate terminals, or a rotary switch may be used to select the active tap.

Basic Resonant Tuner 4 (Fig. 5).

In all the previous examples, we can tune the secondary to resonance with C_T. We also have some control of the coupling and impedance transformation by choosing the primary and secondary turns, when we wind the transformer.

In this example, a variable capacitor is placed in series with the low-impedance primary winding. This "input capacitor" is

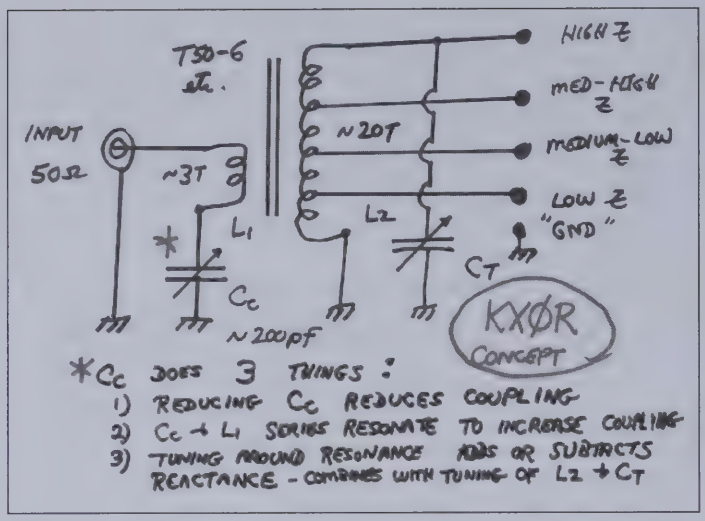

Figure 5

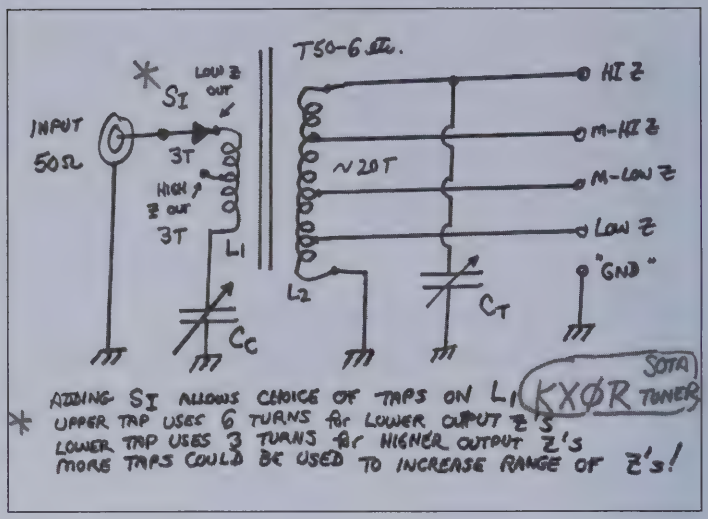

Figure 6

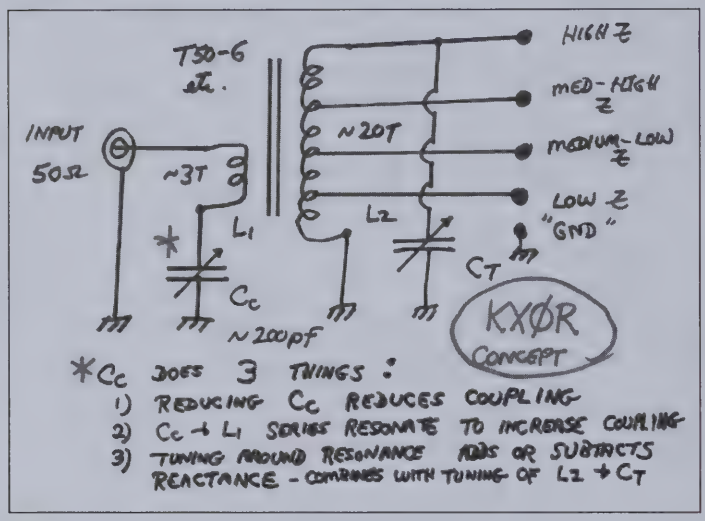

Figure 7

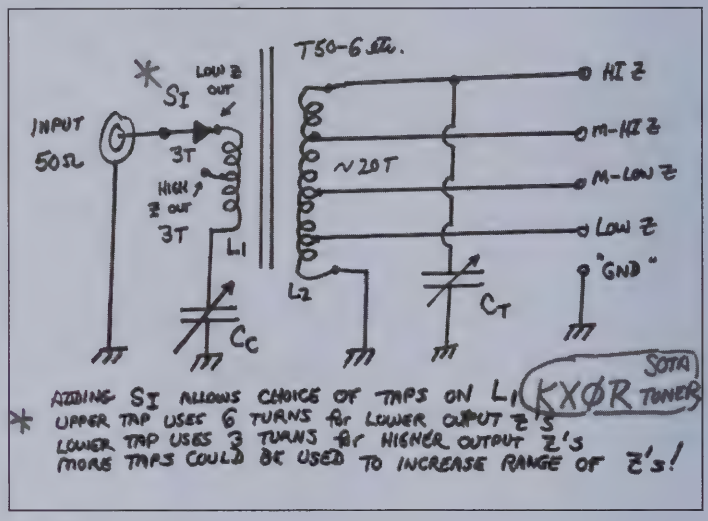

Figure 8

chosen to create a series resonance with the primary winding, more or less.

This series capacitor has a very powerful set of effects on the transformer:

1. When L_1 and C_C are tuned near series-resonance, the coupling between the windings is increased, because more current flows in the primary winding L1.
2. As we tune the primary circuit off-resonance, we both change the coupling and add or subtract reactance from the input network.
3. A new voltage transformation ratio and complex impedance is passed through the transformer to the secondary circuit consisting of L_2 and C_T.
4. The secondary parallel resonant circuit also may be adjusted, to help correct the complex load impedance with the combined impedance available in the tuner circuit.
5. Whatever changes we make in the secondary with C_T are coupled to the primary, so that we may need to adjust C_C again to correct any remaining reactance or resistance error.
6. Even though the two capacitor adjustments interact considerably, each changing resonant frequency, mutual coupling, and net reactance, we can often obtain an acceptable match, with only a few quick adjustments of the two knobs.
7. The range of impedances that can be matched is greatly increased by having two variable capacitors, because the series primary resonant circuit is closely coupled and transformed to the parallel resonant secondary circuit, and the reverse is true as well.

This is much easier to do than to explain in detail. This basic circuit has been in use for many decades, both in transmitters and tuners, and it has numerous variations.

The key idea is that with just two variable capacitors we can control at least four parameters of our tuner:

1. Frequency of operation—resonance of our system
2. Impedance ratio
3. Coupling (related to Impedance Ratio)
4. Reactance correction

In order to cover a really wide range of impedances, we still need multiple taps on the secondary, or some similar technique.

Basic Resonant Tuner 5 (Fig 6).

The turns on primary L_1 are increased,

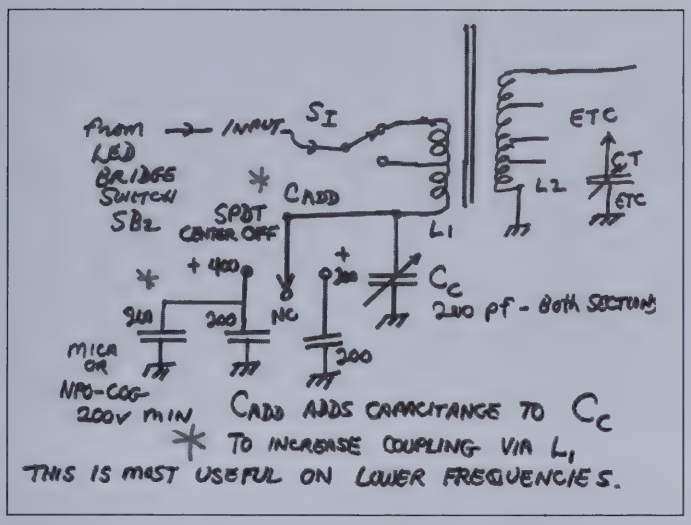

Figure 9

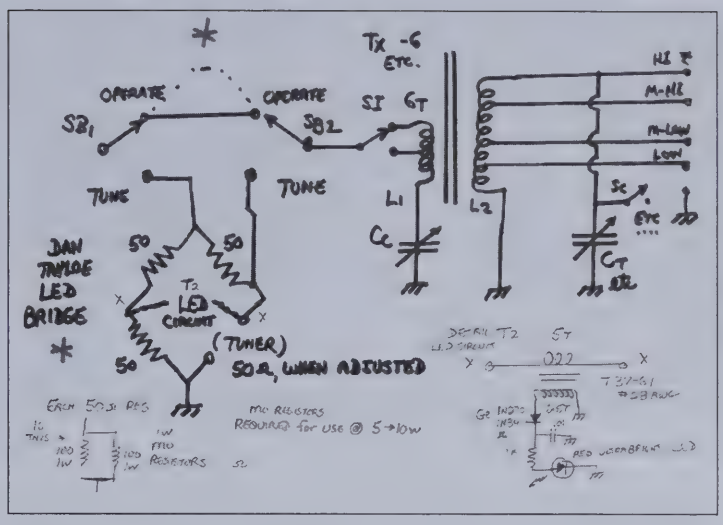

Figure 10

and a tap is added, with a switch to select a shorter or a longer primary. This provides a higher or lower voltage step-up ratio. Selecting different primary turns makes a major change in the tuner; with the larger primary, inductance is added, so the series-resonant circuit of L_1 and C_C changes. This interacts with the secondary side, so that a different set of allowable impedance values is available.

Generally, using more primary turns helps us match:

1. A lower frequency
2. A lower output impedance
3. Certain reactance values

Several primary taps could be included, along with a rotary switch, allowing numerous combinations of allowable impedance ranges for the total network. In practice this may be overkill, but we see this kind of control, using multiple taps on both windings, in the Fuchskreis tuners, etc.

If we try to match a single wire to operate over several amateur frequency bands, a wide range of impedances will be presented to our tuner. In practice a single primary winding is not always enough to cover all the impedance combinations we may need. Adding one switch to increase the primary is very powerful, when combined with the continuous adjustment of the variable input capacitor C_C.

Figure 7—First improvement to C_T.

This is a simple change to C_T. A polyvaricon capacitor with two sections is used. A small section, about 60 pF, is used for the higher frequencies. The larger section of the polyvaricon, about 140 pF, is switched in parallel by switch S_C, for the lower frequencies. Using the small section has two advantages for the high frequencies:

1. The tuning rate is less critical - it is easier to adjust the null
2. The minimum capacitance is a few pF less than with both sections, extending the upper frequency limit.

The switch S_C and wiring must have very low capacitance, to avoid losing the highest frequencies.

Figure 8—Second improvement to C_T.

1. A switch S_A is included to add fixed capacitors to the larger polyvaricon section, often ~140 pF.
2. A SPDT switch with a center OFF position is used for S_A
3. Either 200 pF or 400 pF may be added.
4. Fixed capacitors are mica or C0G/NP0 ceramic—200V or more.
5. 60M and 80M bands may be tuned with the added capacitance.
6. Note that the new circuitry is added to the 140 pF side of the polyvaricon, so that the 60 pF section is not increased and "pulled down" by the added capacitance of S_A.

Figure 9—Improvement to C_C.

A switch C_{ADD} is included to add capacitance to the input variable capacitor C_C. This is a SPDT switch with center off. Either 200 or 400 pF may be added.

1. The added capacitance increases the coupling of L_1
2. The adjustment range of C_C is increased
3. Either 200 pF or 400 pF may be added.
4. Fixed capacitors are mica or C0G/NP0 ceramic—200V or more.
5. The improvement is mostly needed on the lower frequencies

Figure 10—LED tuning bridge.

A Dan Tayloe-type LED Bridge is included, so that the tuner may be easily adjusted. These LED bridges are included in popular tuners like the BLT, etc., and they make matching a small tuner much easier. They also provide a reasonable load for the transmitter while tuning, avoiding possible damage to the final transistors.

The tuning bridge is improved by using metal oxide (MO) resistors—not carbon film or carbon composition resistors. 1W and 2W MO resistors are very small, almost non-inductive, and they tolerate some abuse, not changing their value very much when overloaded slightly. If you have a 10W radio, the bridge resistors should be able to withstanding the full 10W for a few seconds without damage. I use a parallel pair of 100 ohm MO resistors for each 50 ohm bridge resistor. Use the best you can find—some small ones are rated for 2W.

Tuning should be done at low power, usually around 1-2W input, to avoid stressing the bridge resistors. If you forget and start calling CQ with the bridge switch in

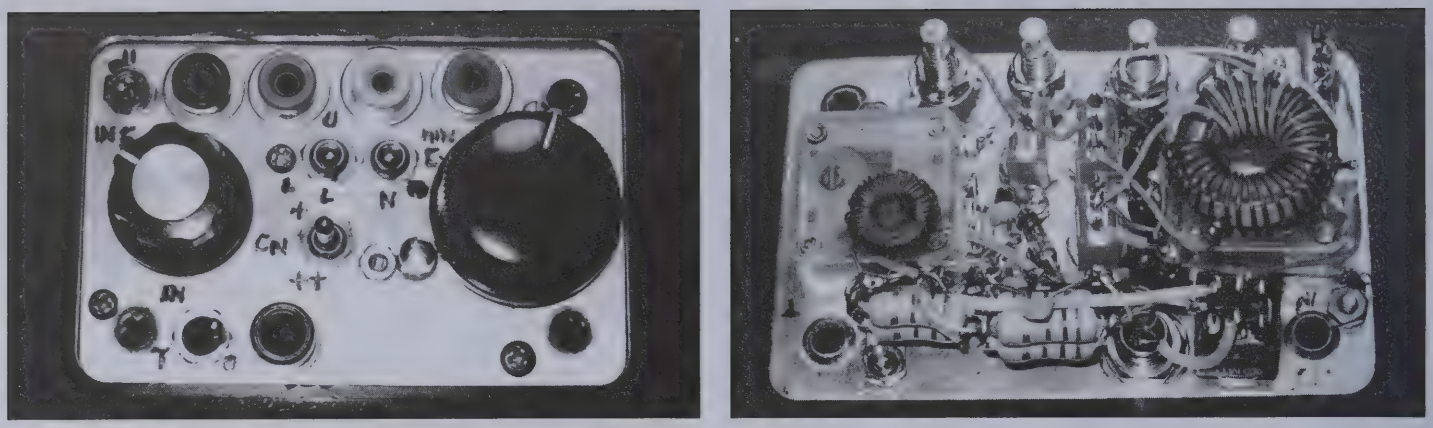

Figure 11—Left (a) front view. Right (b) backside with components.

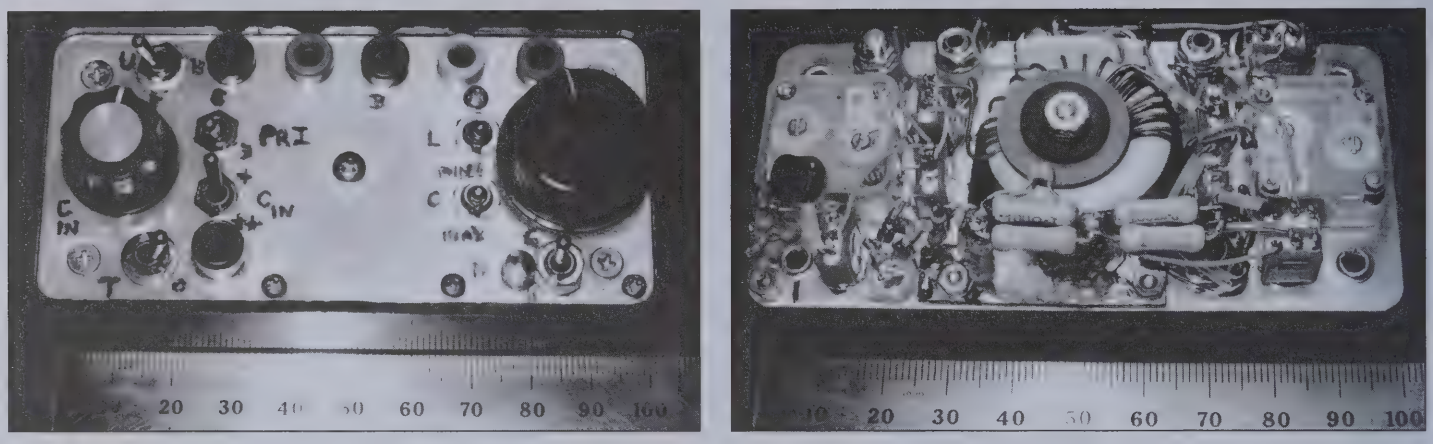

Figure 12—Larger version: Left (a) front view. Right (b) backside with components.

the TUNE position, so you have 3/4 of your 10W going into the bridge resistors—this is 2.5W for each 50-ohm arm, or 1.25W per 100-ohm resistor, if they're in parallel pairs. You may make several contacts before you discover the error—I have! That's when you need the better MO resistors!

Choose a non-diffused, ultra-bright or ultra-super-bright LED, rated at 2000 mcd or more. These are worth their cost, and they will make your SOTA life better! The LED should be painfully bright if viewed indoors. You must be able to null the bridge outdoors, even in full sun.

If the bridge is built small and symmetric, it will look like 50 ohms when the tuner is matched, because the tuner itself will be one of the four 50-ohm legs of the bridge. The null of the LED also should occur when all four legs are 50 ohms. Unfortunately errors may exist in these bridges, depending on how they are built, due to stray capacitance and inductance.

I was able to improve the accuracy of my bridges by adding small compensating capacitances, usually in the range of 10-30 pF, across one or more of the bridge resistors. Using a well-calibrated MFJ-259B analyzer, and an accurate 50 ohm load, I was able to improve the accuracy of my nulls above 14 MHz. Compensation is a fine point, not really necessary, but it's nice to know that when the LED is out, the impedance of the tuner, as well as the bridge, is very close to 50 ohms.

When the LED bridge is bypassed, Operate Mode, a little RF leaks across the switch, and the LED lights slightly when the radio is keyed. This little defect is useful for seeing that the RF is going out.

Actual KXØR Circuits

Here are two KX0R tuners (Figures 11a/b and 12a/b). One is larger than the other (Fig. 12). Hopefully these will be useful to build a tuner using the ideas presented here. This is not a how-to-make-it article—experience and improvisation are required.

For best performance, these tuners should be compact, and small wire should be used to reduce capacitance. I suggest wire-wrap wire, or small single-conductor silver-plated Teflon wire. While a PCB could be used, it likely would add capacitance, which adversely affects these circuits at higher frequencies and high impedances. The output impedance may be several thousand ohms, where every pF is a problem—this is the opposite of working with 50 ohms.

Figure 13 is a drawing of the tuner design I use. This is just the combination of the concepts from the drawings up above, posted earlier. Most of the clutter in the photos comes from all the extra switches and connections required to extend the frequency and impedance ranges.

Components:

The polyvaricons I have are marked "TT" and "TTWM". These have a small section of about 2-60 pF, and a larger section about 4-140 pF. These work well generally, and the Q is good compared to other capacitors I use. Fixed caps should be silver mica or C0G/NP0 ceramic, 200V or better.

The sub-miniature toggle switches are made by Mountain Switch—these are

available from Mouser and elsewhere—the E-switch brand is similar—they are great for this application! A good part number to start with is 108-0044-EVX, the SPDT-Center Off switch in my tuners. Other versions are available in DPDT, SPST, etc. The colored output jacks are mini-banana jacks from Pomona (Mouser)—sample P/N Pomona 2142-5, Mouser 565-2142-5. The mating plugs are Cinch (Johnson)—small and simple—sample P/N 108-1002-001, Mouser 530-108-1002-1.

These mini-banana connectors are also nice for making links in antennas.

RCA phono connectors are good for the 50 ohm connections. They're lighter and simpler than BNC, and they pull loose if something bad happens in the field. A sample P/N for the receptacle is Mouser 161-1052. The little boxes came from Radio Shack. I had to remove some extra plastic inside to make room for some added parts.

The larger tuner includes a big T106-6 toroid core; the intent is to minimize transformer loss. A T68-6 would work fine, with different turns counts. The total primary has 6 turns, with a tap at 3 turns. The total secondary is 16 turns total, with taps as shown on the drawing. The secondary is wound around just over half of the toroid, and it measures about 4.1 uH. If you use a smaller core, 4.1 uH is a good value to use for a starting point. The primary of the current version is wound over (among) the low-Z end of the secondary. The toroid is mounted on a cushion of foam insulation, with a single screw and insulated washers to hold it to the panel. The mounting scheme used for the toroid MUST NOT create a shorted turn (closed loop).

This tuner will match many useful loads from about 3.5 to 22 MHz. Performance is optimum in the 40-30-20-17M bands. High Z loads like the end-fed half wave and the end-fed full wave wires are easy to match, as well as low-Z loads like a 1/4-wave vertical wire with a 1/4-wave counterpoise. This tuner includes a switch to isolate the secondary circuit, useful when feeding balanced lines for a dipole, etc.

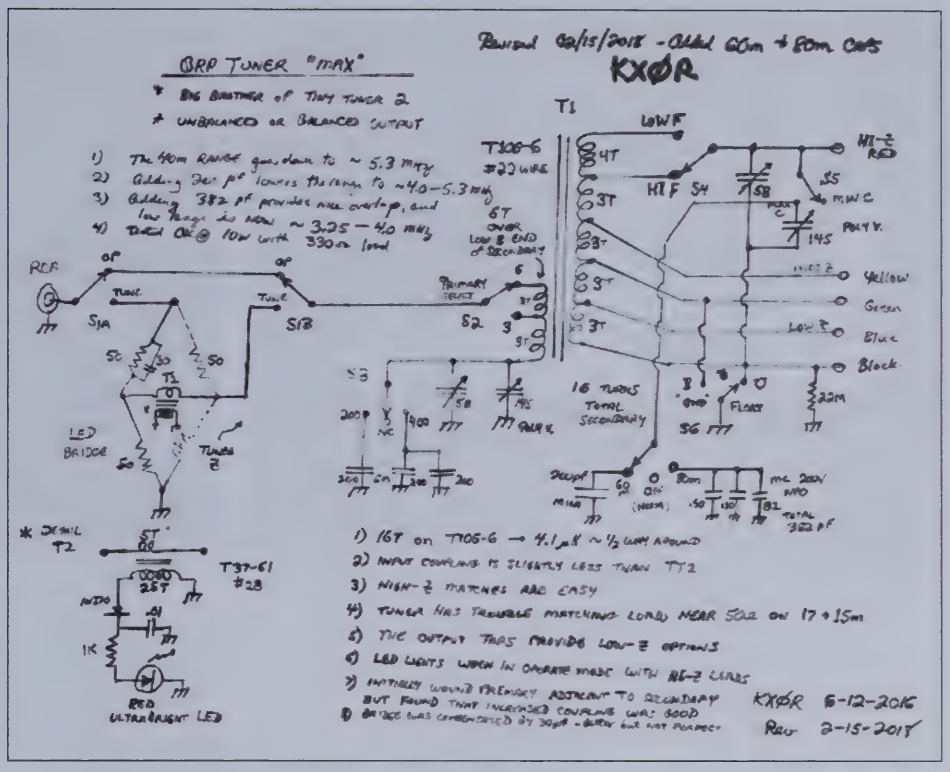

Figure 13—The final tuner design; a collection of all the ideas presented.

Operation:

I regularly use this tuner with an end-fed 66-foot wire. The tuner matches this wire at 7, 10.1, 14, and 21 MHz, with no counterpoise. This antenna is approximately high-Z resonant at 7 and 14 MHz, but it's reactive on 10.1 MHz. The 30M match is as easy as for 7 and 14 MHz, but it's more sensitive to conditions at the site, stray capacitance, etc. No traps or links are needed, but they can be used too. I also employ a 52-foot wire with a 12-foot counterpoise—this has low impedance on 20M, somewhat low Z on 40M, and very high Z on 30M and 17M. All the matches are easy. Occasionally in haste I've omitted the counterpoise and "forced" the low-Z matches using the tuner, and performance is only down slightly.

High-Z loads are just as easy to use as low-Z loads. Various tests on the bench have confirmed that this tuner is reasonably efficient, even when feeding loads near 5000 ohms, as well as below 50 ohms. Power should be limited to 10W, because the polyvaricon capacitors are not rated for high voltage. Likewise, power should not be applied without a load connected. The system should be tuned to band noise before tuning with any power. Using low power and the tuning bridge, a match should be found—only then should full power be used.

When tuning an unknown load, it should first be tried on the highest-Z tap jack. If necessary, it can be moved to a lower-impedance tap; then the tuner is re-adjusted for a better match, etc.

Adjusting these little tuners is somewhat of an art. With repeated use the common settings are learned. Then just little tweaks are needed to get on the air or to QSY. Just adjusting the band noise to peak will result in a pretty good match, especially if the right taps and switch settings are known. Some loads produce sharp tuning settings, but good signals may result anyhow. Broad matches occur mostly with low-Z resonant loads, but low-Z resistors will tune up the same way! Broad matches are not always a sign of perfection in the system, nor are they usually a problem.

In some cases, more than one match may be obtained, with different settings for the input capacitor. This is usually OK. The match with the best null should be used. Resistors can be used to get a feel for the tuner on various bands, at various impedances. Once you "know" a tuner, weird conditions are more obvious. Most tuners have spurious nulls caused by unwanted resonances, but in these tuners, spurious resonances occur at very high frequencies. Spurious nulls can be found by adjusting the tuner at very low power, with the load connections open and shorted. An MFJ-259B analyzer works well for such

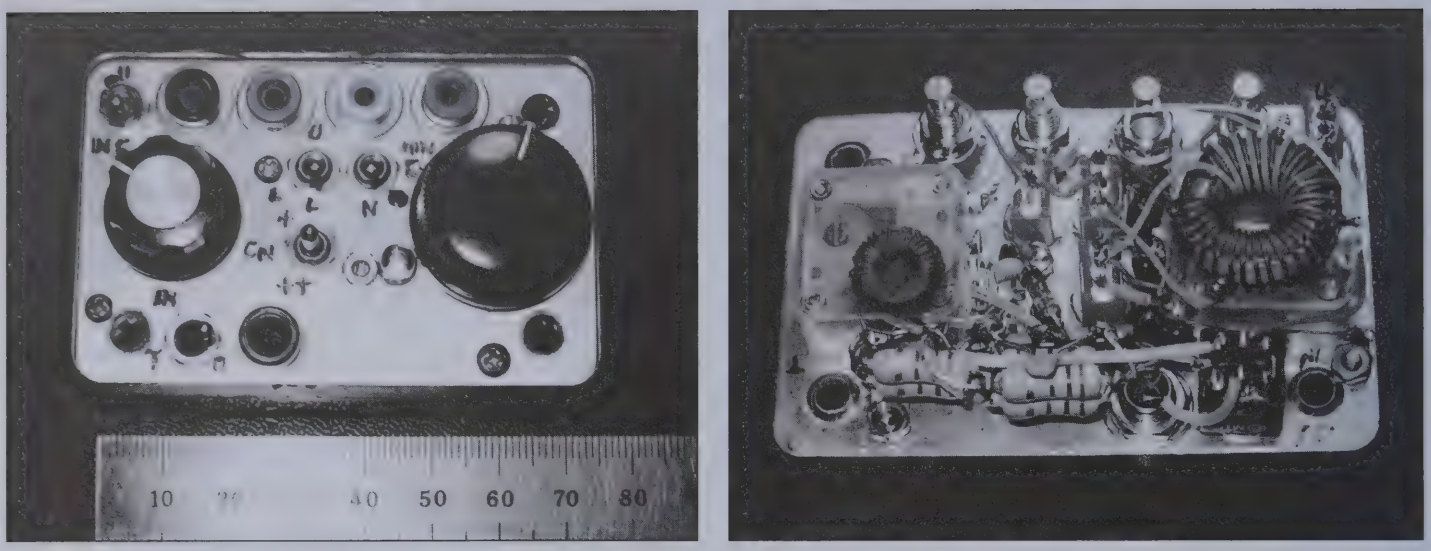

Figure 14 (a, b)—Two views of the Tiny Tuner 2.

tests. As long as the construction is compact, with short leads, unwanted resonances won't be a problem.

Balanced lines may be fed by connecting to a pair of output taps, determined by experiment. Balance may not be perfect, but a match will be obtained. A switch S6 is provided for special configurations. Three configurations are available:

1. GND—a tap on the secondary is "grounded'
2. Center OFF—FLOAT—this is for a floating balanced line, with no "ground" connection to the secondary
3. U—Unbalanced—the bottom of the secondary is "grounded". This is the normal unbalanced configuration for use with end-fed wires, etc.

A 22 megohm resistor is connected between "ground" and the low-Z side of the secondary—this is for use in the "FLOAT" mode, with a balanced line, to drain off static electricity—the tuner would need an actual minimal connection to the ground for this to work—a nail and a wire is enough.

Any impedance-matching RF circuit has loss; there's also loss in traps, broadband transformers, un-uns, baluns, and in small coaxial cable. I use only two feet of RG-316 cable in my system—from the radio to the tuner—my antennas are usually end-fed. Performance has been fun! I've used this tuner for several hundred activations, with decent results.

On March 8, 2019, I activated a local peak, W0C/FR-109. I set up on the ground, which was damp from melting snow. The site is pretty average—nothing special. My 66-foot end-fed wire was about 15 feet high at the top of the bent-over fishing pole, and the far end of the wire was only 2-3 feet off the ground. I used a 12-foot counterpoise, but only for 60M. Running my KX2 at 10W out, I made over 50 CW contacts on 20, 30, 40, 17, and 60M. Included was a 20M DX contact with G4OBK, Phil, in England; another 20M DX contact with EA8/HB9FIH in the Canary Islands, and a 17M DX contact with ZL1BYZ, John, in NZ. I also made S2S contacts with W5ODS in Arkansas and AC1Z in New Hampshire. My RBN spots were good, compared to other activators. This was a normal activation, and not set up at an ideal spot on the mountain. There's no magic—only a tuner that works well—and really good chasers!

The Tiny Tuner 2

Shown in Figures 14a/b, this tuner weighs less than 4 ounces (about 110 g). The Tiny Tuner 2 preceded the larger tuner above; it was re-built from a different, earlier tuner—the Tiny Tuner. That tuner was derived partly from the BLT.

Figure 15 is the original concept drawing and Figure 16 shows the detailed design.

Concept, construction and components are similar to the larger version above. A T68-6 toroid is used, and the detailed drawing shows the turn counts. Note that the turns are different from those on the Concept drawing.

The secondary has 28 total turns, and the entire winding measures about 4.2 uH. The primary has 11 turns total, with a tap 5T from the top end. The primary is wound on the low-Z end of the secondary—see the photo in Fig. 14b.

Operation is very similar to the larger tuner. 60M and 80M are not available, and the circuit is simpler and smaller. As far as I can tell, this tuner is just as good as the larger one, for the 5 bands it

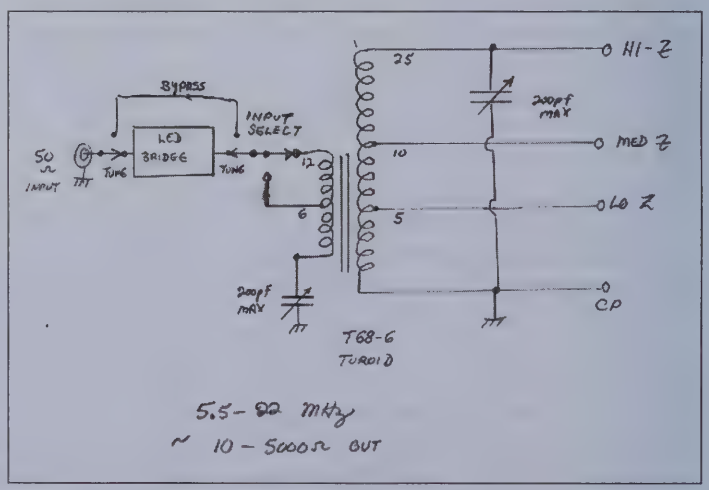

Figure 15—Basic concept of the Tiny Tuner 2.

covers. It handles the 10W from the KX2 just fine!

The Wrap-up

Part of the intent of this article is to make SOTA activators aware that traditional RF rules are meant to be broken, to some degree. Antennas don't need to be resonant, wires may be fed at the end, an actual physical counterpoise is not always needed, a ground is seldom required for SOTA, an effective antenna may be quite low, coax cable is not desirable for connecting to the antenna, and above all—compact, light equipment is better for SOTA!!

Hopefully some of you will enjoy building and using similar tuners as much as I do!

—73, George KXØR

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QRP Quarterly needs your ideas and projects! Contact the editor or any of the Associate Editors to get started!

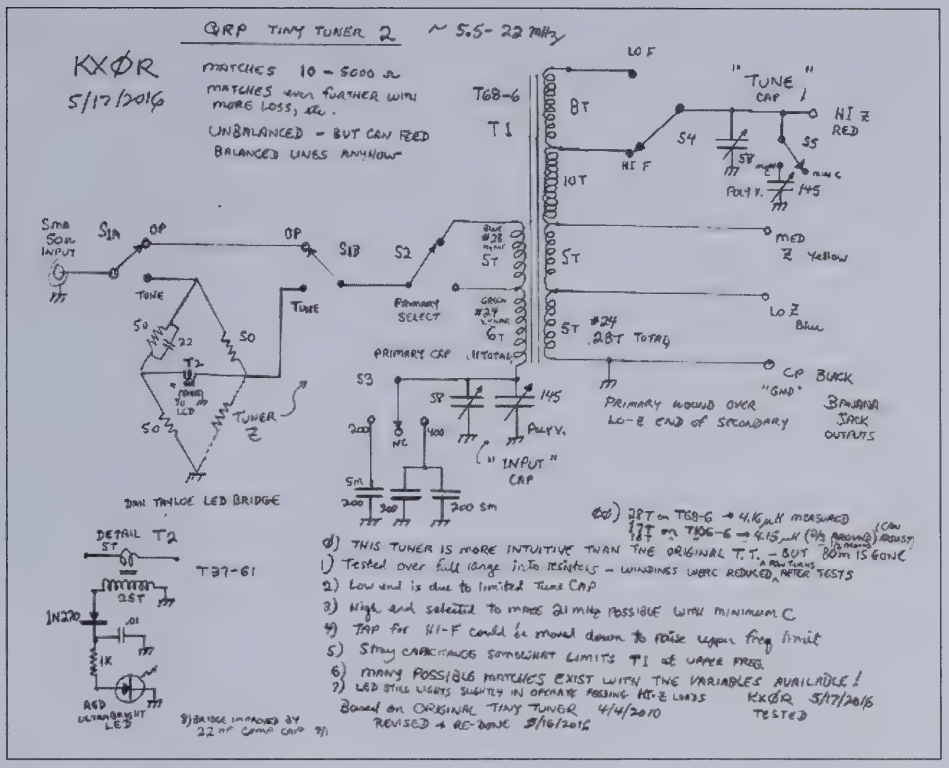
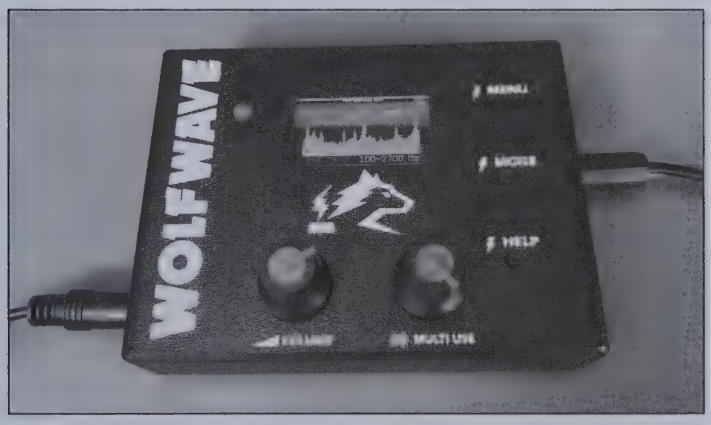

QRP TINY TUNER 2
~ 5.5- 22 MHz
KXØR
5/17/2016
MATCHES 10 – 5000 Ω
UNBALANCED – BUT CAN FEED BALANCED LINES ANYHOW
T68-6
T1
LO F
HI F
"TUNE" CAP
HI Z RED
MED Z Yellow
LO Z Blue
CP BLACK
"GND"
PRIMARY WOUND OVER LO-Z END OF SECONDARY
BANANA JACK OUTPUTS
PRIMARY SELECT
PRIMARY CAP
"INPUT" CAP
TUNER Z
SMA SOM INPUT
TUNE
DUAL TWICE LED BRIDGE
DETAIL T2
T37-61
IN270
RED ULTRA BRIGHT LED
THIS TUNER IS MORE INTUITIVE THAN THE ORIGINAL T.T. – BUT 80m IS GONE
Tested over full range into resistors – windings were reduced after tests
Low end is due to limited Tune Cap
High end selected to make 21 MHz possible with minimum C
TAP for HI-F could be moved down to raise upper freq limit
Stray capacitance somewhat limits T1 at upper freq
many possible matches exist with the variables available!
LED still lights slightly in opposite position HI-Z LO35
Based on ORIGINAL TINY TUNER 4/4/2010
REVISED & RE-DRAWN 5/16/2016
KXØR 5/17/2016
TESTED

Figure 16—Detailed circuit diagram.

New Product Announcement:
SOTAbeams' WOLFWAVE advanced audio processor



WOLFWAVE is an audio processing system. It includes sophisticated bandpass filtering, noise reduction and even age-related hearing correction! All these facilities have been designed to help users increase their enjoyment of voice, data and CW communications.

The unit also includes a useful low-distortion audio test generator that can generate one or two tones for transmitter testing. Another novel feature is an experimental CW Regenerator that gives noise-free CW reception.

WOLFWAVE features a bright OLED spectrum display and on-screen help, all powered by the latest ARM low-power processor with a 20-bit CODEC. There are separate audio outputs for headphones and a loudspeaker.

WOLFWAVE firmware is upgradable so users will always benefit from the latest developments. Such is the flexibility of the hardware that other enhancements are sure to follow!

Details at: https://www.sotabeams.co.uk/wolfwave-advanced-audio-processor/

●●

HT-1A QRP Transceiver Review

James Hannibal—WB9NLZ

The HT-1A is a compact 20/40m dual band CW QRP transceiver from CRKITS that comes in either kit form or fully assembled. I received the fully assembled model, so this review won't cover the kit building process. Even though I didn't build this one, I did take a peak inside.

SMD components are used, but not to worry. All the SMD parts are pre-mounted, and you will only have to solder through hole components.

Measuring 4.33" x 4.09" x 2.32" and weighing in at only 400 grams (14.12 oz), the HT-1A is a great option for hams that enjoy portable operating in the great outdoors. It'd be a good fit for SOTA & POTA activations or even quick LTOTA deployments (Lunch Time On The Air). See Photos 1 and 2.

It has a transmit range of 7.0-7.2 MHz and 14.0-14.35 MHz. Even though this rig only transmits CW, it does have the ability to listen to SSB signals. It also has an extended receive range, which covers everything between 5.9-16 MHz which means shortwave broadcast reception while in SSB mode. Filter bandwidth is set at about 300 Hz for CW and 1.8 KHz for SSB. Spurious suppression is no worse than –50 dBc. I was impressed that the receiver is surprisingly sensitive considering the size and price of the radio. Using simple base loaded MFJ single band telescopic whip antennas with no counterpose and no grounding, I was able to copy quite a few QSOs on 20m and 40m.

RF power output is 5 watts with 12 volts input power, but it can handle up to 15 volts. However, the transceiver can be powered off a 9 volt battery in a pinch if needed. Speaking of batteries, this little guy even has room to install an internal lithium ion battery pack! Current consumption during receive is about 60 milliamps with the display backlight on and only about 45 milliamps when the backlight is off. During transmit, the HT-1A draws 1 amp.

No internal speaker is provided with the HT-1A, however there is plenty of room inside the enclosure to install a small speaker and audio amplifier. I used a tiny external LiPo powered amplified speaker and a set of headphones to keep things simple. Photo 3 provides a look inside the box.Photo 4 is a better view of the circuit board and parts layout.

Photo 1—Front panel view.

The HT-1A has some great features for such a small and affordable QRP transceiver. These include: 16 user programmable memory channels, built-in keyer for iambic paddles, full break-in QSK, RIT, XIT, AGC, S-meter, and even side tone selection. The HT-1A can even automatically detect whether you are using paddles or a straight key. The built-in keyer is adjustable from 5-40 words per minutes and is set at 15 WPM by default.

I was able to easily fit it into a small rugged waterproof case along with a couple single band telescopic whips for 20m/40m, a small 12v LiPo battery, headphones, a MK-11 Pocket Spy Micro Straight Key, and a bulldog BD6 Mini Iambic Key.

I had a blast with this compact QRP rig. It's just so easy and fun to use! With an interface consisting of only 2 buttons, 2 knobs and an on/off switch, you can learn to operate the HT-1A in just a couple minutes and without ever reading the user manual. I think this ease of use makes it a great option for preppers who typically want a compact affordable emergency backup transceiver. Plus,

Photo 2—Portable operation is simple.

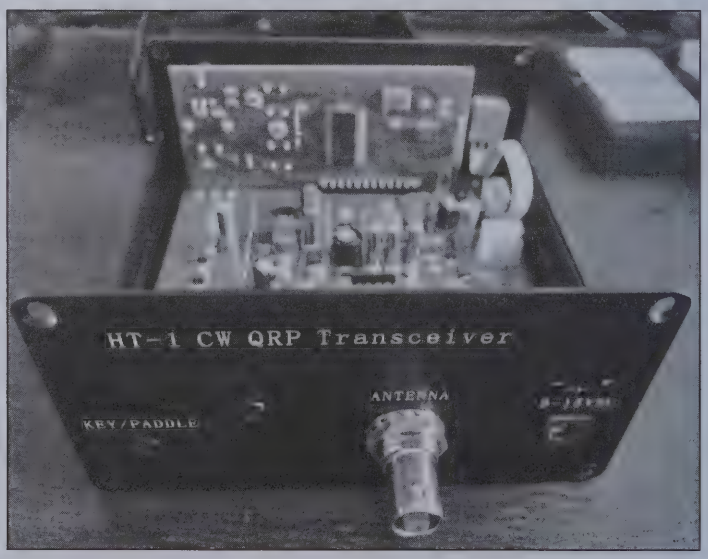


Photo 3—Lots of room inside the case.

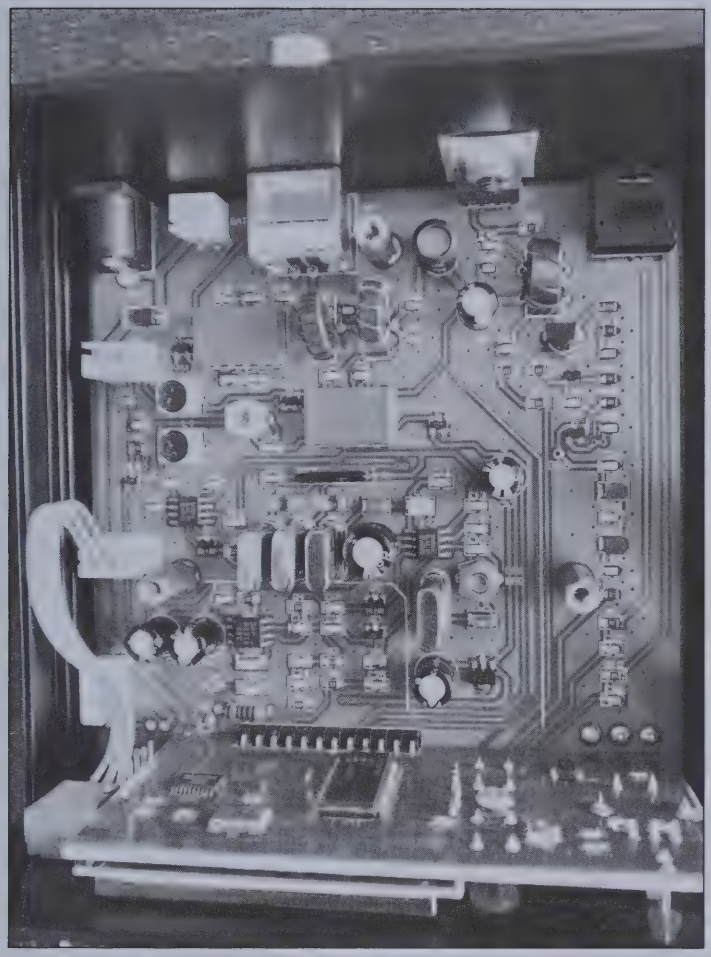


Photo 4—Circuit board and inside layout.

Chassis Dimensions: 110 x 59 x 104 mm (not including protruding parts like knobs)
Weight: About 400 grams
Power supply: 9-15 V DC
Current consumption—
During RX: About 60 mA when backlight is on and about 45 mA when backlight is off
During TX: About 0.8 A (@ 12 V)
Local oscillator: DDS, reference frequency 54 MHz
Display: LCD
RF output power: About 5 W (@ 12V)
RX: 5.9-16 MHz continuous (peak sensitivity only in 40 m and 20 m bands)
TX: 7.0-7.2 MHz and 14.0-14.35 MHz
Side tone: 600 Hz
Keyer: Built-in, 5-40 wpm adjustable
Memory: 16 memories, user programmable
RX mode: CW, SSB (LSB only if it is below 10 MHz, and USB only if it is equal or above 10 MHz)
AGC: Audio derived AGC with S-meter to show relative strength just for reference
QSK: Full break-in
Spurious Suppression: no worse than –50 dBc
Filter bandwidth: about 300 Hz for CW and 1.8 KHz for SSB
Antenna Connector: BNC
Audio Connector: 3.5 mm
Key Connector: 3.5 mm

Technical Specifications

you don't have to take much time to relearn the interface if you haven't used it in a long time.

The HT-1A from CRKITS should appeal to a wide demographic of ham enthusiasts, builders, beginners, preppers, SOTA, and especially the budget savvy ham crowd. If you fit into any of these categories, then I highly recommend you take a close look at this great little dual band 20m/40m CW transceiver.

Kit price is $150 USD; fully assembled price is $175 USD. It is available for purchase at the following links:

http://crkits.com
https://qrvtronics.com/CatHAM_Radio/Products/HT-1_CW.htm ●●

The most common reasons for missing an issue of *QRP Quarterly*:

1. **Forgot to renew your membership/subscription**
2. **Forgot to notify the club of your address change (long ago, so now the forwarding order expired!)**

Check your membership status on the club website!
www.qrparci.org

Life is Too Short for QRO

A ramble through QRP philosophy with some practical ideas along the way

George Dobbs, G3RJV (2008 FDIM Presentation)

"To the man who only has a hammer in the toolkit,
every problem looks like a nail."
Abraham Maslow

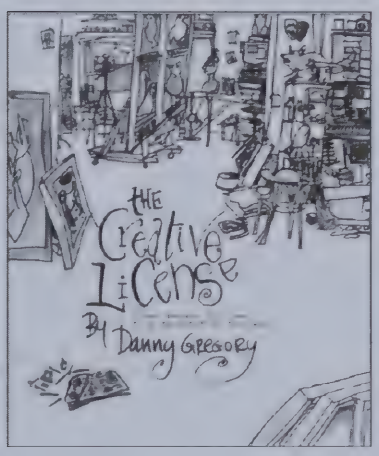
After my presentation in last year's FDIM, one of the regular attendees approached me and commented that I had included "less philosophy" in my talk. So this year I decided to be heavier on QRP philosophy and lighter on my dubious simple electronics. This makes my written proceedings somewhat more difficult since including all my ramblings on the subject would thwart the impact of my presentation. So these notes offer a mere favour of my thoughts plus some little circuit ideas that have amused me over the last year.

My wife and I have a modest property in Wales, set between the mountains and the Irish Sea, that we visit for peace and refreshment and to explore local Celtic sites. During my reading there, I have come to enjoy the work of the Welsh poet R.S. Thomas; a rather moody Welsh clergyman who died a few years ago. Perhaps my favourite poem is "The Bright Field" which says…

The Bright Field
I have seen the sun break through
to illuminate a small field
for a while, and gone my way
and forgotten it. But that was the pearl
of great price, the one field that had
treasure in it. I realize now
that I must give all that I have
to possess it. Life is not hurrying
on to a receeding future, nor hankering after
an imagined past. It is the turning
aside like Moses to the miracle
of the lit bush, to a brightness
that seemed as transitory as your youth
once, but is the eternity that awaits you.
R. S. Thomas

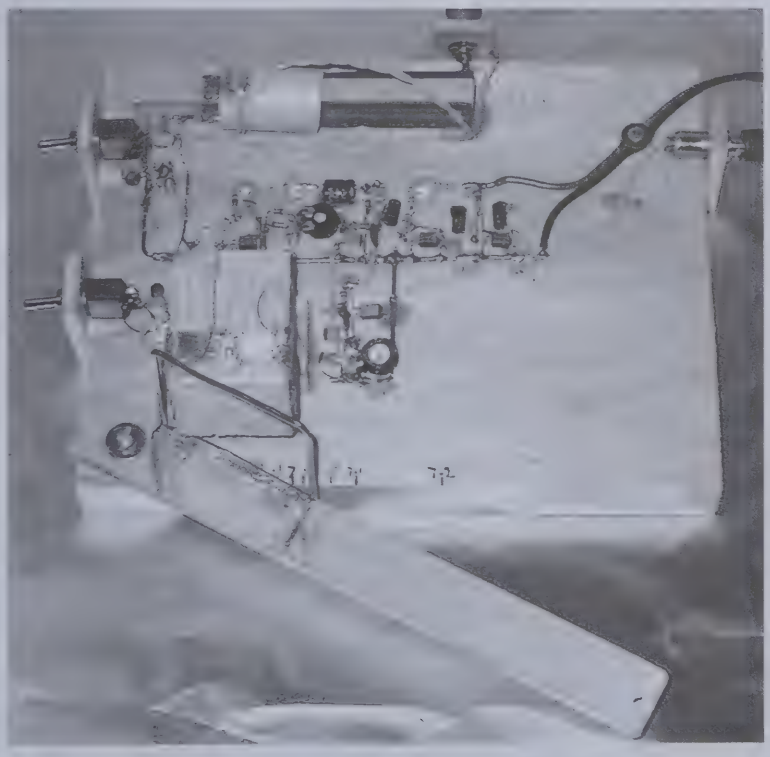
"Life is not hurrying on to a receeding future, nor hankering after an imagined past. It is the turning aside like Moses to the miracle of the lit bush" seems to sum up exactly why I do QRP. When he saw the burning bush, Moses said, "Now let me turn aside and see this great sight." The word he would have used for "turn aside" is the Hebrew "Soor" which means to "put away" or "leave alone." Let me put away what I am doing and devote my attention to this.

The value of any real hobby is being able to turn aside from the usual pressures of life and concentrate of something different; something of choice, something which does not have to be done. We should value the "amateur" in our radio. "Amateur" of course comes from the French (from the Latin) *amator* meaning "Lover." Something done purely for the love of it. Thankfully, this can lead to quirky, unusual and creative approaches to a subject. Genuine creativity is in short supply these days.



In his wonderful book, "The Creative License: Giving Yourself Permission to Be the Artist You Truly Are," Danny Gregory writes, "Through the history of our species, ordinary people have always made paintings, sung songs, decorated their homes, expressed themselves in a hundred ways. Today, however, we are increasingly creatures who expect others to provide us with entertainment and culture. We take for granted that creativity is the domain of professionals. We are convinced that if we cannot be perfect, we should not try."

Geert Paulides, PA7ZEE, produced a delightfully novel and simple receiver for 40 and 20m with an interesting method of tuning. He decided that variable capacitors were expensive. Geert saw the Wayne McFee, NB6M, "Tin Ear Receiver" with permeability tuning; a brass screw forms a core moving in and out of the VFO coil. He attempted a version using a wooden stick with a single shorted turn moving towards the coil. Combined with a mixer and audio amplifier, his VFO formed the heart of a simple and unusual receiver.

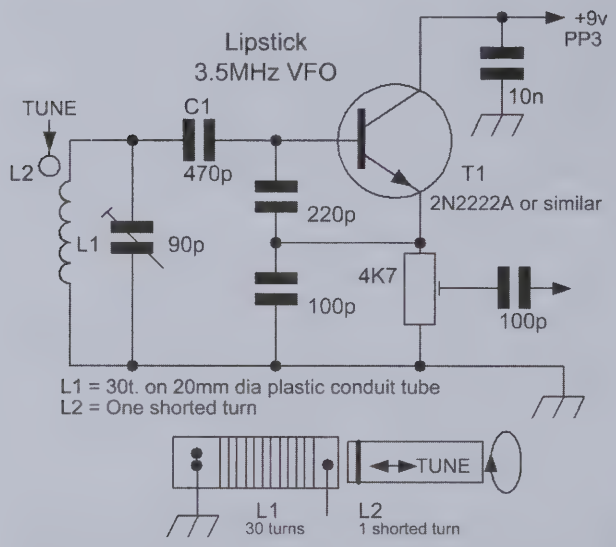


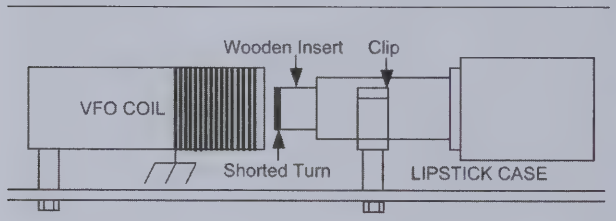
I like a novel idea so I decided to try my own version of the PA7ZEE VFO.

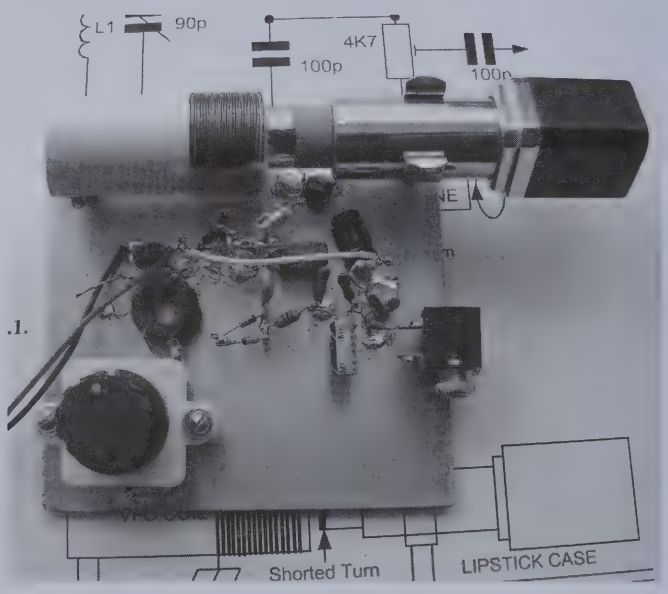
I called it the "Lipstick VFO" because in place of the wooden stick, I used the mechanism from one of my wife's discarded lipsticks to move the shorted turn in relation to the VFO coil. The lipstick gel is removed from the mechanism (a messy job involving a knife and lots of hot soapy water) and replaced with a piece of wooden dowel rod holding the shorted turn.

The circuit is a Colpitts Oscillator using capacitive feedback and a generic npn transistor. An evening of experimenting and a fair amount of compromise produced a surprisingly stable VFO at 3.5 MHz. The mechanics are simple using a coil wound on 20mm electrical conduit tube (standard in the UK).

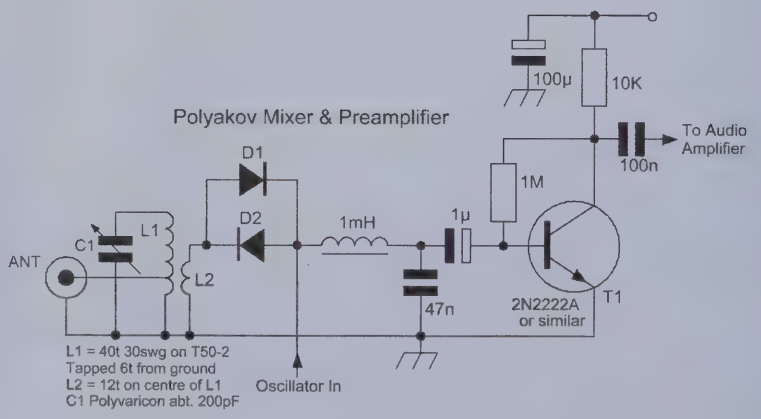
A spring tool clip holds the lipstick case in place which is aligned with the coil using stand-off pillars. The diagram and picture show it well.







As a practical example, I made a simple 40m receiver using a Polyakov mixer. This circuit, from RA3AAE, uses two diodes which function as a mixer and also as a doubler. The 3.5 MHz VFO is thus able to drive a 7 MHz receiver. A single tuned circuit pre-selector gives basic selectivity and a single stage audio pre-amplifier enables enough drive for an audio amplifier. Not the most sophisticated receiver in the world but it did receive a good range of European stations on 40m.



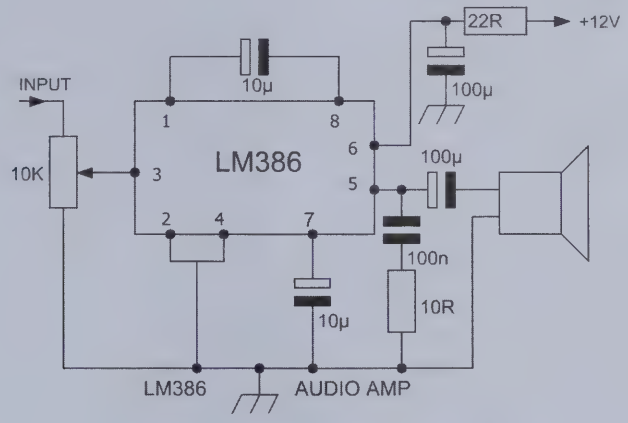
QRP changes time...

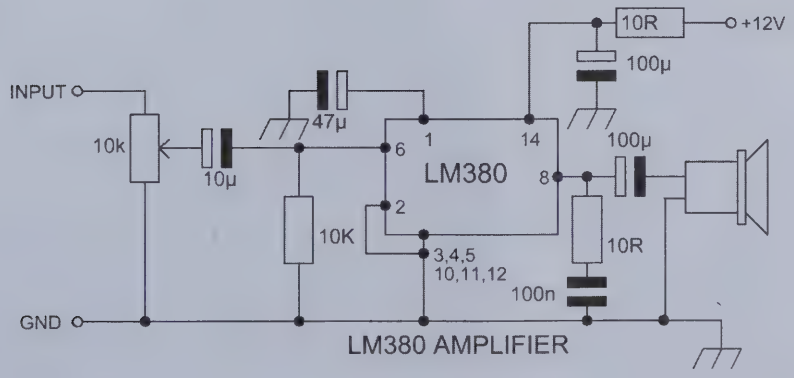
Time is an odd phenomenon, we see it as linear (past, present and future) but it can be circular. The Greeks had two ways of expressing time, *kairos* (pronounced ky-ros) and *kronos*. Clock time, the way we measure linear time in our "real" world is kronos (chronology). Kairos time is the dimension of time we are absorbed into. While chronos is solely quantitative, kairos has a qualitative nature. We sometimes talk about "quality time" and that does not have a sequential nature. Whenever you engage in activities, that nourish your soul, you are in kairos time. We participate in kairos time, rather than racing to catch up with it.

Kairos time may occur during shared time with loved one, creative activities, reading a well written book, listening to music or any activities that are personally meaningful to us. One is wholly absorbed in the moment, unhurried and unaware of time passing. We all know experiences when "time stands still." We are so absorbed by what we are doing that all sense of time is lost. QRP activities transport us into the realm of kairos time. When you switch on the radio, or switch on the soldering iron, chronological time is left behind.

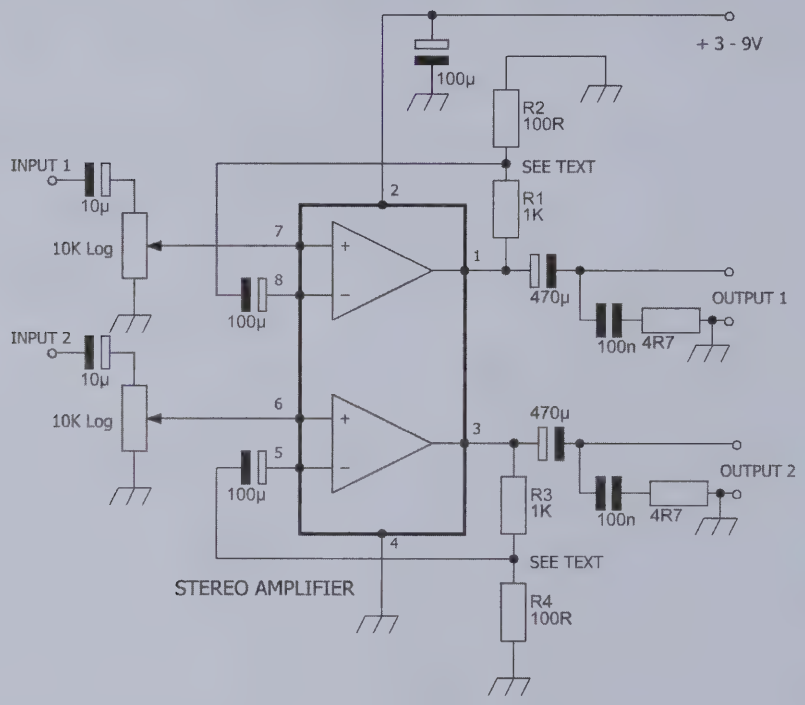
Those little amplifiers...

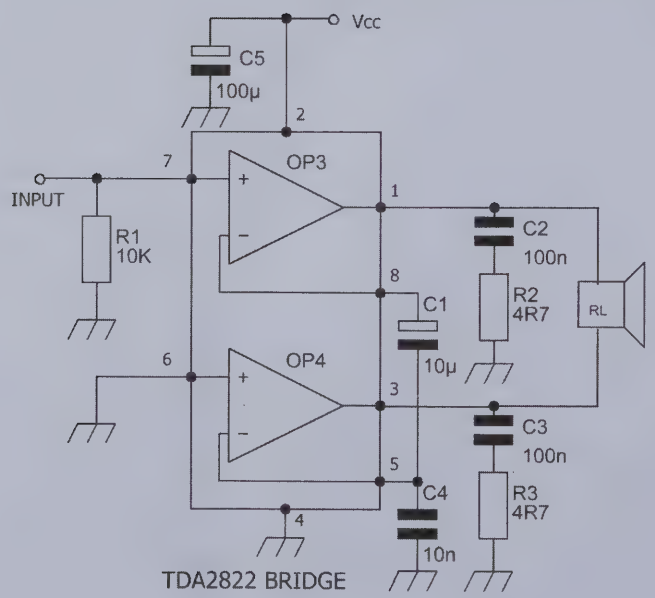
The receiver described above requires the addition of an audio amplifier. Like many QRP constructors, I would probably turn to the LM386 or the LM380. You know the approach....





Recently I was pointed towards another little amplifier chip that is available at very low cost—the TDA2822. The TDA2822 comes in the 8 pin DIL configuration, although there is a less common 16 pin DIL version. It is a dual amplifier designed for stereo applications that can be operated with a surprisingly wide supply voltage (1.8 to 9 volts). The total harmonic distortion is quoted at 0.5%. Power output is a little low, at about 0.65 watts in stereo operation and just over 1 watt if both amplifiers are used in a bridge circuit; both of these figures are for a 6 volt supply. It has about 40 dBof gain in the bridge arrangement.





I have found it a useful, and expensive, headphone amplifier when used in the bridge arrangement in simple battery powered receivers.

I am indebted to Bill Mera, of "Soldersmoke" fame, for pointing me towards a deeply interesting paper called "Shop Class as Soulcraft" by Matthew B. Crawford. Crawford praises creative manual skill and the satisfaction it can yield. He writes:

"The satisfactions of manifesting oneself concretely in the world through manual competence have been known to make a man quiet and easy. They seem to relieve him of the felt need to offer chattering interpretations of himself to vindicate his worth. He can simply point: the building stands ….the car now runs ….the lights are on."

"So what advice should one give to a young person? By all means, go to college. In fact, approach college in the spirit of craftsmanship, going deep into liberal arts and sciences. In the summers, learn a manual trade. You're likely to be less damaged, and quite possibly better paid, as an independent tradesman than as a cubicle-dwelling tender of information systems."

Matthew B. Crawford, "Shop Class as Soulcraft,"
The New Atlantis, No. 13, Summer 2006, pp. 7-24.

Craftsmanship
The thing that is handmade, by a craftsman, has no desire to last thousand upon thousands of years, nor is it possessed by a frantic desire, like mass-produced objects, to meet an early end. It follows the round of days; it drifts along as the current carries us along together. It wears away little by little, it neither seeks its end nor denies it: it accepts it. Between the timeless time of the museum and the speeded up time of technology, craftsmanship is at the heartbeat of human time. A thing that is handmade is a useful object but also one that is beautiful. An object that lasts for a long time but also one that slowly ages away and is resigned to so doing. An object that is not unique like a work of fine art, it can be replaced by another object that is similar but never the same. The craftsman's handiwork teaches us to live and hence to die.

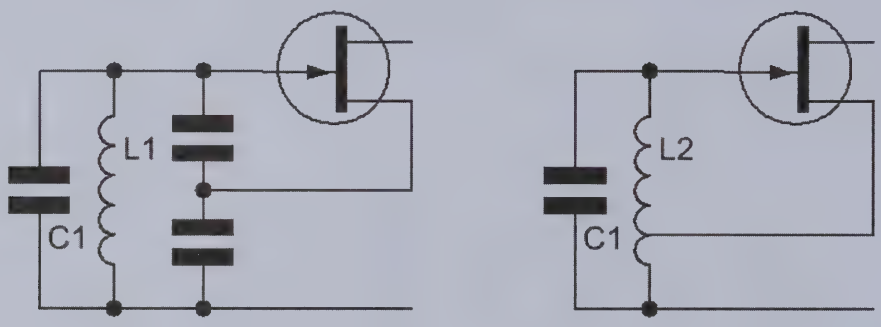
From "In Praise of Hands" by Octavio Paz:

Things Men Have Made
"Things that have been made
with weakened hands,
and put soft life into,
are awake through years
of transferred touch,
and go on glowing for long years.
For this reason,
some old things are lovely,
warm still with the life
of forgotten men who made them."
D.H. Lawrence

Mr. Hartley's Oscillator

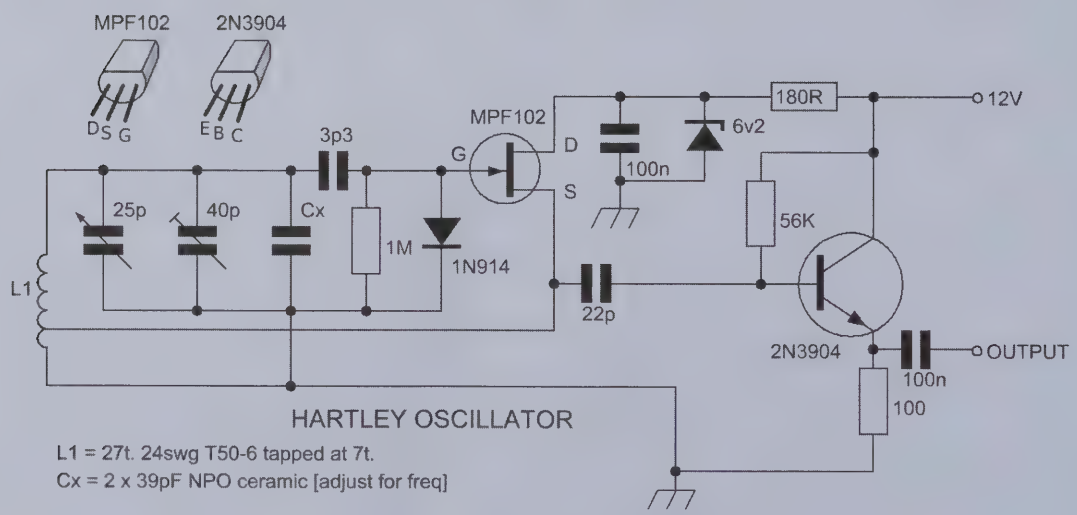
I guess that most radio builders have their favourite oscillator of choice. Mine is probably the Colpitts. Variants of it have worked well for me over the years. Recently I have been doing a little soldering iron doodling with Hartley oscillators. I think I have underestimated their worthiness in the past.

The Hartley oscillator was conceived by Ralph V. L. Hartley when working for the Western Electric Company in 1915. The difference between the Colpitts and Hartley oscillator is illustrated in Figure 1. Each oscillator has an amplifier, a tuned circuit and a divider network to feed some of the output signal back to the input to maintain oscillation. The Colpitts oscillator (a) uses a capacitive divider network for the feedback, the amount of feedback determined by the capacitance ratio of the two capacitors. The frequency is controlled by the tuned circuit (C1 and L1). The Hartley oscillator (b) uses inductive feedback. C1 and L2 form the tuned circuit and L2 uses a tap, a connection near the bottom of the inductor, to introduce the feedback to the input. The amount of feedback is determined by the position of the tap.



(a) Colpitts (b) Hartley

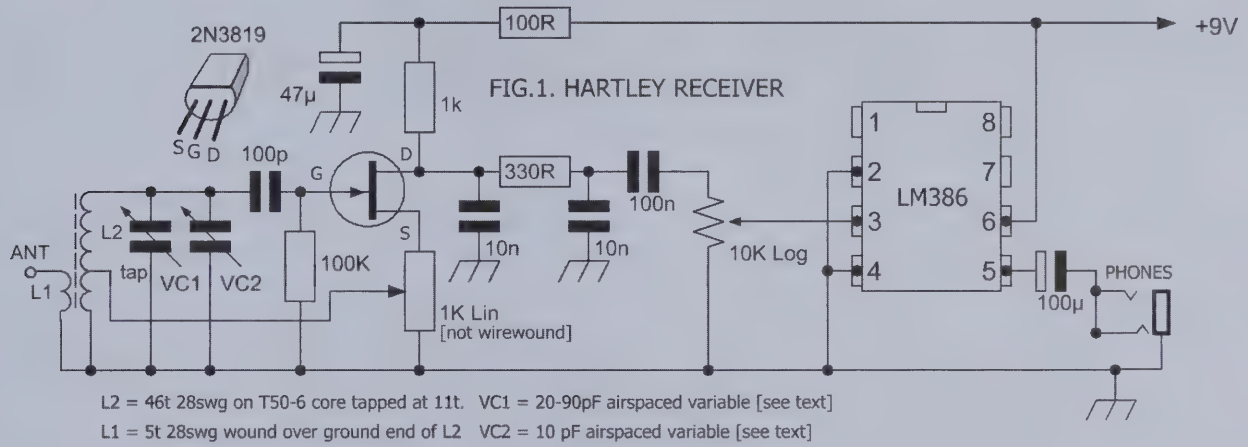
Figure 1.

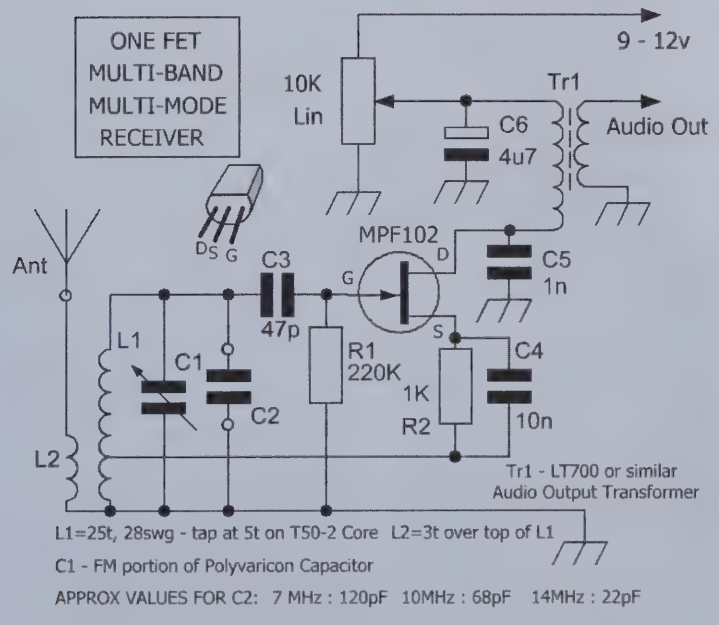


I decided to try a Hartley oscillator for the 7 MHz band. The circuit roughly follows the design criteria in that fine book, *Experimental Methods in RF Design*, by Wes Hayward, W7ZOI, and others. The frequency determining components are to the left of the circuit isolated by the 3.3 pF series capacitor. The inductor is 27 turns of 24 s.w.g. enameled copper wire wound on a T50-6 core. The winding is

tapped 7 turns from the ground end of the winding. The capacitors in the tuned circuit are made up of the main tuning capacitor (25 pF), a trimmer capacitor (40 pF) and a parallel padding capacitor (Cx). The value of Cx is determined by experimentation with the trimmer capacitor available for fine adjustment. I used NPO capacitors to make up the value of Cx. A useful tip is to use several capacitors to achieve the desired frequency. Several smaller value capacitors will be more temperature stable than one larger capacitor. I found that two 390 pF capacitors brought me close enough to the band for the trimmer to achieve 7 MHz when the tuning capacitor was fully meshed. The result was a VFO with good stability and desire to try Hartley oscillators more often.

The Hartley Oscillator can also form the heart of a simple regenerative receiver. The example shown here is a version of a receiver by Tony Fishpool, G4WIF. Tony's design is called "The Two Dollar Regen" and was an entry in a regenerative receiver building contest at HamCom 1999 in Arlington, Texas. VC1 has capacitive range of about 15 to 90 pF. VC2 is a smaller value variable capacitor used as fine tuning control. I found one with only three vanes and roughly a 10 pF capacitive range.





Another version of the Hartley receiver is a one-FET, multi-band, multi-mode receiver! The tuned circuit uses C1 and C2. C1 is the FM section of a polyvaricon variable capacitor of the type used in the older AM/FM. radios. The one I used has an FM section with a capacitive range of some 5 to 25 pF. C2 is a parallel capacitor to bring the tuned circuit into the desired tuning range. I arranged for C2 to be a plug-in component, so that by changing the value, different tuning ranges can be achieved. I found I could hit the 7 MHz band by using 120 pF, the 10.1 MHz band by using 68 pF and the 14 MHz band by using 22 pF. So it really is a multi-band receiver! C2 should be

a ceramic NPO-type capacitor to eliminate frequency drift. The output load for the MPF102 is an audio transformer used to drive headphones. In practice the audio output is very low so unless the listener only wants to listen to broadcast stations, I suggest the output is connected to an external audio amplifier.

So… A few thoughts and a few little circuit ideas to try.

Small Joys

"My advice to the person suffering from of lack of time and from apathy is this: Seek out each day as many as possible of the small joys, and thriftily save up the larger, more demanding pleasures for holidays and appropriate hours. It is the small joys first of all that are granted us for recreation, for daily relief and disburdenment, not the great ones."
Herman Hesse

This article from 2008 is one of many presentations made by George G3RJV at QRP ARCI's Four Days in May. He was a favorite of the audience every time he spoke — with a unique combination of wit, wisdom and practical notes on technical topics. He will be missed! —Editor

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The Last Page — Some Technical Notes

W6IPA 20m Portable Antenna Design using Buddipole Whips
John VE3IPS

John W6IPA created a 3D project for the 20m portable antenna coil. It's on Thingiverse:

https://www.thingiverse.com/thing:3197539

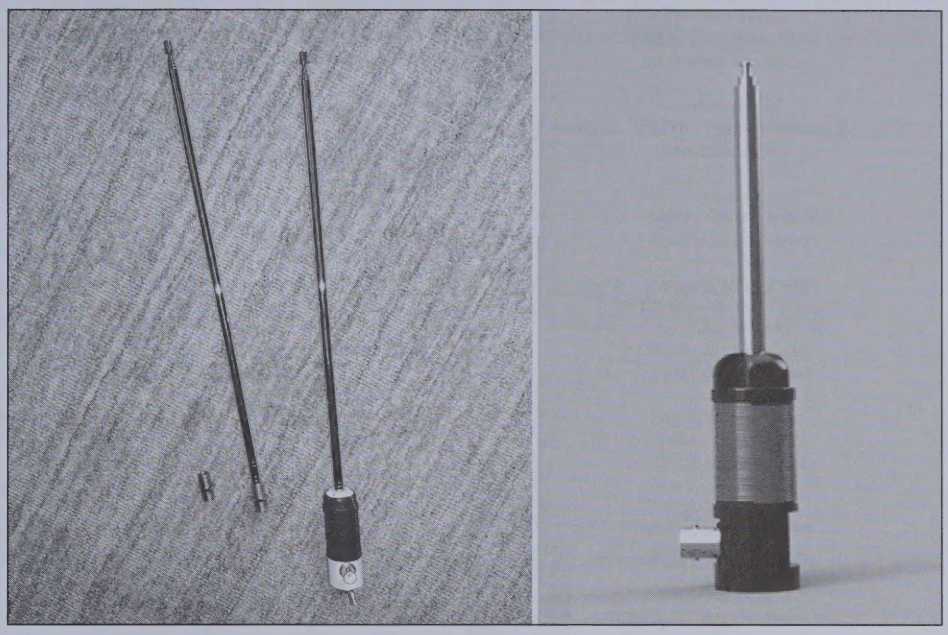
For my version, I used the Buddipole Featherweight whip that has a 1/4" thread on the base. These antennas are cheap. Get info at:

http://www.buddipole.com/fetewh.html

Get a couple of BTS IT adapters as it will allow a FW whip to fit onto a 3/8" stud mount. You don't need it for the project but it's useful to create other antenna designs. I use the BST IT adapter at the base of the antenna and a mount in my design

You do need a counterpoise of about 11 to 14 feet to get best SWR and it's possible to lower the whip elements and shorten the counterpoise for use on 17m and 15m

See ya'll at Xenia at the Buddipole BUG Meet Up, or at FDIM 2019



VE3IPS' portable antenna (left), based on a design by W6IPA (right).

Quarter-Wave Stub Article Part 2
Al Duncan VE3RRD
ve3rrd@sympatico.ca
https://barriearc.com/builders-group

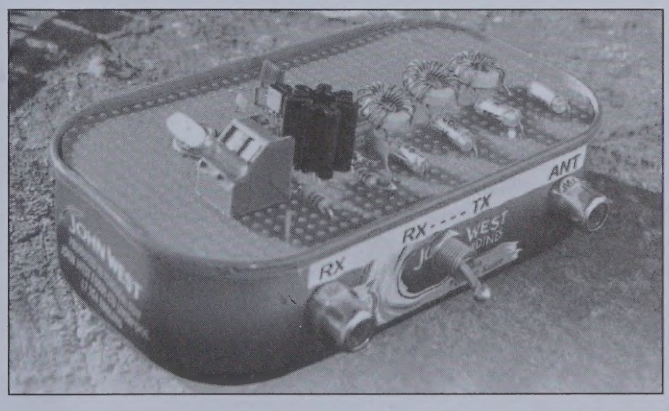
Here are some additional thoughts related to my article "Cheap HF Quarter-Wave Stubs" in the January 2019 issue of *QRP Quarterly*.

I had an interesting email from Paul WØRW who says he has a complete set of stubs that he uses as grounded drag wires for his Pedestrian Mobile operations. When operating at high altitudes or during snowy conditions he uses the stubs to ground the input of his transceiver to protect it from precipitation static. He says that since the velocity factor of the coax makes the stub shorter than a quarter wavelength, his stubs have a few extra feet of wire soldered to the shorted end so they make a full quarter-wave radial.

This method could also work well for making a resonant quarter-wave counterpoise from the stub for portable field use. If the coax quarter-wave stub was kept off the ground 3 feet or so and lengthened with a piece of wire to make it a quarter wavelength long, then each stub could work for two purposes. The "inside" of the coax would be a shorted quarter-wave stub filter, and the "outside" of the coax (plus extension wire) would be a resonant quarter-wave counterpoise wire. No doubt others have already thought of this. The extra piece of wire can be left permanently soldered to the far end (shorted end) of the coax stub. It will have no effect on the resonant frequency of the coax shorted quarter-wave stub filter. The ground (shield) side of the coax is extended in length slightly with the added piece of wire so that it is a normal quarter-wavelength long when it is stretched out in a straight line. The overall length (coax stub plus extra wire) would be 468/MHz feet in length. The coax shorted-stub filter is slightly shorter than 468/MHz because of the velocity factor of the coax. You can only use one band stub/radial at a time connected to the T-connector for the particular band you are transmitting on. In order to reduce ground losses (and reduced antenna performance) with a counterpoise wire that is laying on the ground, it should be kept 3 feet or so above the ground.

Of course it may be just as easy to keep the shorted quarter-wave stub in a compact coil (to be connected to a T-connector at the transceiver), and use a separate piece of regular insulated wire for a counterpoise. This is what I do, so I don't have to keep coiling up the lengths of stub coax that I have been using. I use two or three short fiberglass "driveway markers" pushed into the sod to support the counterpoise wires 3 feet above the ground when I am camping or otherwise set up in the field.

●●



In memoriam, here is G3RJV's Tuna Tin transmitter!

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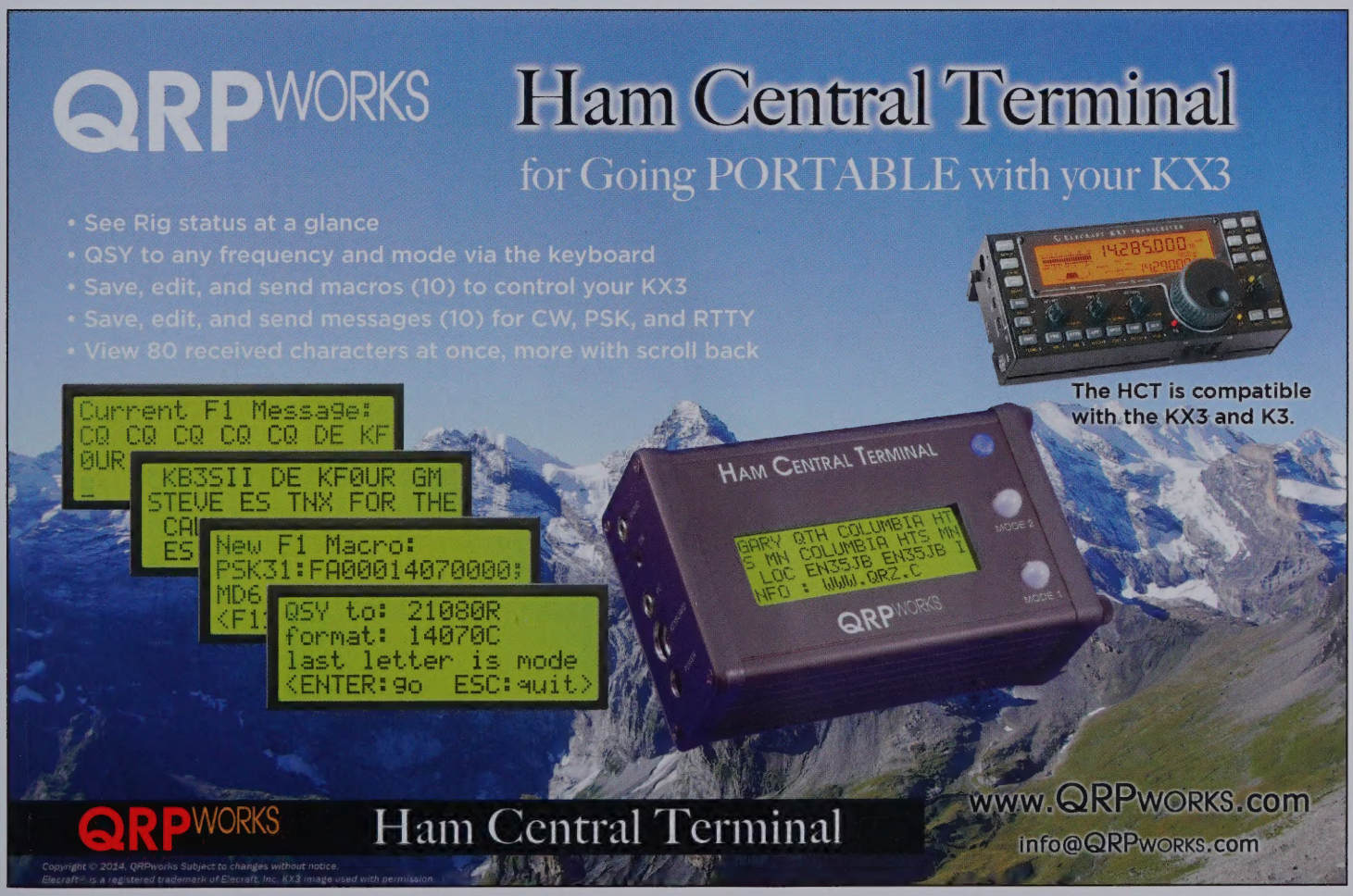
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